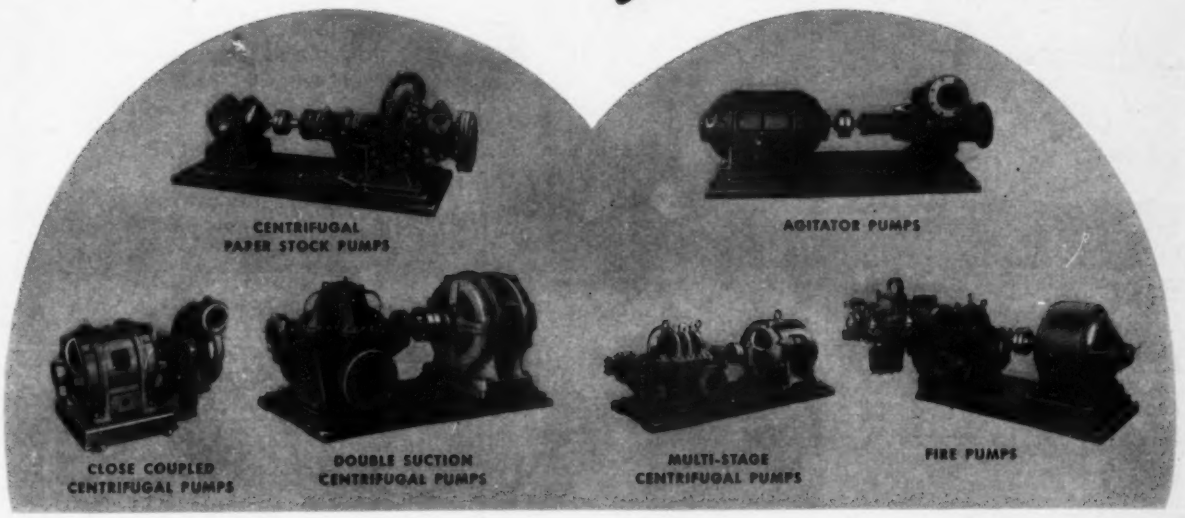
The Heart of the Mill



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THE PAPER INDUSTRY

JANUARY, 1936
Vol. 17—No. 10

A MONTHLY EDUCATIONAL JOURNAL
Devoted to the Interests of the Pulp and Paper Industry

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EDWARD B. FRITZ, Publisher
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PUBLICATION OFFICE
Chicago, Illinois
333 N. Michigan Ave.
Dearborn 8877

Eastern Office
New York, N. Y.
342 Madison Ave.
Murray Hill 2-7358

Pacific Coast Office
Los Angeles, Calif.
1031 S. Broadway
Westmore 8501

Entered as second-class matter at the Post Office at Chicago, Illinois, February 13, 1920, under the Act of March 3, 1879. Subscriptions in the United States, Alaska, Hawaii, Philippines, Porto Rico, Cuba and Mexico, $2.00 per year. Canada, $2.50 per year. Other countries, $3.00 per year.

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Happy New Years!

WE ARE looking into the face of the happiest New Year we have ever seen. However, it is not the certainty that 1936 will be a better year than 1935, that intrigues us, but rather the conviction that 1936 is to be the open door to a succession of happier years to come. Therefore, it is with an amplified gratitude that we wish all our readers many happy New Years.

How the world can resist the impulse to doff its hat in grateful congratulations to the American people for the superb way in which they have laid the groundwork for a magnificent come-back from the world-wide depression, passes all our understanding.

America endured its domestic and international problems with a civilized patience, christian fortitude and rectitude of conscience such as the world never before beheld. For four long years, they sweated and wrestled, sometimes puzzled, often confused, with the various angles of the depression problem, persistently searching for the solution. Never before does history record that so great a nation experimented, so freely, so consistently and so bloodlessly, with so many political panaceas, in its determined endeavor to solve its difficulties righteously, as the people of these United States have so nobly done during the past three years. "If capitalism caused all our confusion in 1932, then give socialism or any other 'ism' a chance to prove their beneficient claims," seems to have been the attitude of the voters.

Democratic procedures for the time were held in abeyance and a combination of socialism and fascism was given the right-of-way. Government by person instead of by legislative enactments was permitted a trial by almost unanimous consent.

But, when in the course of developments, it became apparent to the people that in order to bring in "the more abundant life," they must forfeit all those individual and corporate rights under which, during the past 160 years, they had converted this vast continent from an uncivilized wilderness to the greatest, richest, freest nation on earth, they constitutionally rebelled. Then came the definite turn-back to the right. The skies began to clear and the right-of-way back to national industrial recovery appeared. The true resumption of progress, onward and upward, began. Industry and agriculture got behind their courts, the guarantors of their priceless liberties. The people demanded the return to government by legislative enactments instead of by executive orders.

Wheels began to whir again in constantly increasing numbers. Business activity, which had become subservient to political activity, took forward plunges, but best and finest of all, the revived common sense of the American people reasserted itself to such an unmistakable degree that in the last six months of 1935, the expansion of business, the gain in employment and payrolls, together with the return of an unshakable confidence of the people in the basic worth of their country and its institutions, has produced a veritable material miracle.

Of course, it is hard to believe after years of gruelling losses and sufferings, yet it is true—a miracle and nothing less. Let the skeptics read the following result of figures taken from the last weeks of December,

1935, and compared with the corresponding weeks of 1934:

	Per Cent Increase
Automobile production	350
Steel Ingot production	100
Pig Iron production	120
Freight carloadings	16
Electric power production	13
Lumber production	45
Building permits—215 cities	100
Wholesale commodity prices	5
Earnings—151 representative corporations	25
All listed stock—N. Y. Stock Exchange	30
Factory employment	10
Factory payrolls	25

What is behind those figures?

The unalterable, determined spirit of Americans to succeed.

Undaunted by the terrific devaluation of their wealth, unafraid of any of their experiments to their political health, yet determined to retain all the good those experiments revealed, undefeated by all the assaults,—from without as well as from within the nation,—on their institutions, customs and rights, the people of these United States are emerging triumphant from the welter of all their woes in a manner and by a means which will eventually point the rest of the world to the right solution of their depression problems.

Remember the N. R. A.

IT has been written that "The evil that men do lives after them; the good is oft interred with their bones." You may recall this statement from Shakespeare's "Julius Caesar," and staunchly believe in the truthfulness of it. You may even be able to cite example after example to prove your contention. Yet, it might be proven with equal emphasis that the opposite likewise is true. In fact, how much more worthwhile and pleasant it is to think of the good that has or can come from an experience rather than harboring contrary thoughts.

Most assuredly, such is the case of the N. R. A.—all powerful for a time, but now generally forgotten except for some of its failings.

In spite of these failings, the N. R. A. had its good points. It tended to develop unity of thought within the executive channels of the industry. It made the executives of the industry more conscious of the gravity of the economic situation than would have been possible otherwise. It all but eliminated the chiseler and price cutter by stabilizing prices at a time when ruinous price cutting competition ran rampant. It tended to break down barriers that had developed between the several divisions of the industry and to remove bigotry, fear, hate, contempt, distrust and other equally insidious attitudes of mind from the executive group.

It made of this group one large family; made this family better acquainted individually and collectively; and made it appreciate that in unity there is strength, and that co-operation in the family is a stronger force for good than dissension.

In other words, it developed a closer and more friendly relationship among manufacturers, both non-competitive and competitive, than would have come about naturally at the time. It made each of them more tolerant of the other; made them realize that there are problems of mutual interest that can be solved best by concerted action; and taught them that there is some good even in the worst.

All in all, the N. R. A. was a good thing for the pulp and paper industry. There are few who will deny it. Therefore, before it is too late and keeping in mind only the good that came from it, may the suggestion be made to remember it.

The Open Office Door

DO YOU make it easy or difficult for those under you to come to you for the purpose of discussing purely business matters or matters that might be considered as only of personal interest? Just what you do in this respect depends largely upon your sympathetic understanding of the needs of human beings.

The easier that you make it for your employees to reach you the easier it is for them to present ideas gained from their experience that may prove profitable to you.

Your employees may be and probably are more familiar with the details of their individual jobs than you are. This statement is made in spite of the fact that you may have reached your present executive position from the ranks. It is made because there are too many details involved in the production of pulp and paper for any individual to be completely familiar with the best way of doing everything in connection with all of them.

Constructive suggestions for improving conditions often can be supplied by members of the working force if the office door is open and you make it known that such suggestions will be welcome. It is difficult, however, to get suggestions from a group when the closed door is a barrier to their approach.

The term, "closed door," of course, has been used literally. Your office door might be open twenty-four hours of the day and yet be closed more securely than if locked if you have failed to develop this closeness of feeling on the part of your employees both for you and the organization of which you are a part.

The same thought may be applied to matters of purely personal problems. Sometimes a little kindly advice on the part of a senior in rank would do much to obliterate worry from the minds of those under him and make for greater operating efficiency. The open or closed door attitude, however, would determine the freedom with which such problems might be discussed and might actually be responsible in an intangible way for an accident or some other equally distressing situation. What has been your attitude in this respect?

3 in a Row

DECKERING CAPACITY

OLIVER-YOUNG FILTER

In a large mill producing southern kraft, each of the 6 x 10 Oliver-Young Deckers is handling from 250 to 315 tons per 24 hours, discharging at 13% consistency. One of the Deckers is handling direct from screen 8000 G.P.M. of 0.70% feed.

WHITE WATER RECOVERY

NEW OLIVER SAVEALL

In a mill making 12 oz. #2 grade hanging paper, one of the new Oliver Savealls is reducing white water losses from 20 pounds to less than 0.4 pounds per 1000 gallons.

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In a mill where chlorinated kraft is handled, the chlorine content is reduced from 8% to 0.05% on an Oliver-Young Washer.

These three performance records are indicative of what up-to-date Oliver Pulp Filters and Washers are capable of doing. Consider the value of such performances if applied to your problems.

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"Somebody's Got to Pay the Freight"

By WILLIAM SIBLEY

JUST A FEW days ago I was with a group of advertising agency executives discussing the placement of some space advertising for a prominent industrial firm. Of chief interest in this conference was the sales manager of an influential trade journal who was trying earnestly to sell some of his space. As a minor and somewhat irrelevant point in his assertion to meritorious claim to a place in the appropriation, that sales manager made this remark: "We are going to raise our space rates along about June or July. . . . With all these social security taxes coming along, plus the other governmental drains, somebody has got to pay the freight!"

And there you have in a nutshell, gentlemen, the coming prevailing attitude of business men everywhere, in every endeavor. No suggestion was made, or thought advanced, concerning increased value for those increased rates. Larger circulation, a better product, or a more resultful medium was not the consideration. Merely that "with all these social security taxes coming along . . . *somebody has got to pay the freight.*"

With the beginning of 1936, America takes its first nationally decisive step toward what is termed "social security." The federal unemployment insurance plan went into effect January 1. The first collections for it will be due December 31 next. It is a new venture for us; one entirely strange to our history. The Old-Age Insurance Law will go into effect the first of January, 1937. The first old-age pensions will be paid during 1942. This is another new venture for us; another strange diversion.

A year ago we looked forward to 1935 with much more hesitancy and temerity than we now have while facing 1936. One year ago we were actively afraid of a major war. . . . not a war that might come in some vaguely future time, but one that surely would be here within the next twelve months. We were actively fearful of a complete economic collapse; one which would blot out the progress thus far made by our present-day civilization. The expected war did not come, and, on the whole, economic conditions are much better today than they were twelve months ago.

The thing that did make the most progress during 1935 was neither war, collapse, nor an "ism." Communism, fascism, socialism—even pessimism—made little progress during 1935. What *did* gain foothold was "social security" and the old-age pension idea as fathered by the somewhat retiring physician from Los Angeles County. True, the Townsend Plan is not yet enacted and probably never will be. But it has brought about off-shoots and compromises in the form of "social security" laws and old-age pensions, both national and state. And as some of us are already beginning to learn . . . "somebody has got to pay the freight."

Today, and reckoning from January 1, 1936, every employer in the United States with a payroll of eight or more persons (with certain minor exceptions), must pay a tax of one per cent of his total payroll. During 1937, this tax will be two per cent, and thereafter three per cent. This tax may not, under any consideration, be deducted from the employee's wages or salary, nor may the employee be permitted to contribute to the tax.

These funds will be collected by the Federal Government (either directly or through the several states) where they will be held in the separate account of the Unemployment Trust Fund of the United States Treasury. This money will be paid back to the states, for unemployment compensation only, as need arises. The first reckoning by the Federal Government will be made as of December 31, 1936.

Quite regardless of whether we, as individuals, agree with or dissent from pensions, unemployment insurance, doles, bonuses, grants, or "welfare funds" —the rising tide of such enactments is going to make our products higher, our service more costly, *without* a corresponding increase in either quality or value. And that is economically unsound.

In the case of the publisher cited in the first paragraph, there was a limit to the appropriation being divided. With 25 per cent increase in space rates, that publisher will get a 25 per cent decrease in lineage. And that decreased lineage will mean decreased business for the advertiser. Applied broadly, that principle can mean only one thing: reduced income for both the publisher and the advertiser; and regardless of the percentage applied to payrolls for unemployment—a reduced amount for *all* payrolls.

During the coming years, sales managers everywhere and in every line will be shrugging their shoulders and explaining the increased prices by the mere statement that "somebody has got to pay the freight." That's right. Somebody has. But figure it out for yourself. If your equations are correct, the answer will be found to be: YOU.

THE PAPER INDUSTRY
A MONTHLY EDUCATIONAL JOURNAL

Can Electrical Equipment Failures Be Anticipated?

E. L. DOTY, Co-ordinating Engineer
Service Department
Westinghouse Electric & Manufacturing Company

ELECTRICAL equipment failures, except those caused by lightning, fires, floods and suddenly abnormal operating conditions, can be anticipated—that is, they can be prevented. It is generally the habit to think of such failures as electrical or insulation troubles, whereas many of them are strictly mechanical failures and a surprisingly large percentage, although electrical, are due to mechanical causes. It is still a question whether faulty lubrication or single-phase operation has caused the highest induction motor mortality.

It will be assumed that the electrical equipment has been correctly designed and manufactured; that it complies with the standards of the American Institute of Electrical Engineers, and of associations governing particular industries; and that it has been thoroughly inspected and tested during the processes of manufacture. This should preclude defects except those occurring during shipment and handling.

The equipment should be inspected carefully upon its arrival at destination and any damage discovered should be reported to the transportation company and to the manufacturer. If a machine is brought from cold surroundings into a warm room it should be kept covered until its temperature has risen to room temperature so as to prevent condensation on the windings and other parts. Care should be taken in transporting and handling apparatus to make sure that the windings or other delicate parts are not damaged. A blow upon any part of the windings is liable to injure the insulation and result in short-circuited or grounded coils.

The location for electrical equipment should be given careful consideration when laying out a plant. Architects and industrial engineers are giving more and more thought to this subject, particularly when designing buildings for paper mills and other industries, using processes requiring high temperatures and the use of chemicals and large quantities of water. Electrical equipment should not be exposed to moisture from leaky pipes, escaping steam, the spray from discharge pipes or condensation of atmospheric moisture on overhead glass or a metal roof. It should be protected from the corrosive action of acid fumes or other injurious gases and from dirt from coal-handling or other sources.

As the total temperature, and consequently the capacity of electrical apparatus and equipment, depends upon the temperature of the surrounding air, it is evident that its location should be in a place as cool and well ventilated as is consistent with proper protection from dirt and moisture. The position of such equipment always should be such that parts that require special attention are accessible for inspection and adjustment.

Incorrect alignment of rotating apparatus may result in bearing troubles, in undue coupling stresses, end thrust, vibration, unequal air gap, unbalanced magnetic pull, high temperatures and other abnormal conditions, and may cause either mechanical or electrical failures—sometimes both.

Unbalanced rotors, beside setting up vibrations in the apparatus, foundations and building structure, may cause poor commutation, flashing at the brushes and commutator or collector rings, or even the loosening of mechanical or electrical connections. Balancing operations always are desirable after a rotor has been repaired or rewound. This is particularly important if it operates at high speed.

Electrical equipment must be connected and adjusted correctly or satisfactory service will not be secured. Troubles and failures do not always occur where the mistake has been made. Wrong connections may result in death or injury to individuals or in serious damage to apparatus located many miles away, and faulty adjustments may affect the operation of remote equipment even more than they do the apparatus or devices that are incorrectly adjusted.

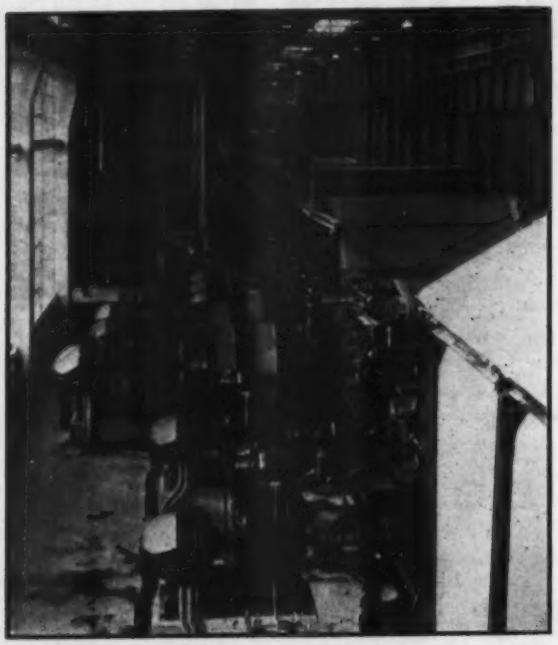

Fig. 1—Sectional paper machine drive installation. Totally enclosed forced ventilated motors assure adequate ventilation and full protection against moisture and atmospheric conditions. The flexible couplings and floating shaft between driving and driven units assure satisfactory operation with slight inaccuracies in alignment.

Approved operating methods and procedure must be followed if electrical equipment failures are to be anticipated in the sense of being prevented. Serious or long continued overloads result in deterioration of insulating and sometimes in mechanical injuries. Low power factor, high voltage, single-phase operation of three-phase apparatus, and other abnormal conditions must be avoided or trouble may be expected. Operator's mistakes may be reduced greatly by the installation of automatic apparatus and devices and modern switching and indicating equipment.

Probably the most important of all preventative measures for anticipating failures is careful maintenance. Sometimes it seems that "Keep the Apparatus Clean and Dry" should be engraved on every nameplate. This injunction does appear conspicuously in almost every instruction book. Periodic application of approved and suitable insulating paints and varnishes should be included in the maintenance schedule. Care and adjustment of brushes is imperative. Proper lubrication and a tight lubricating system should be maintained. Insulation applied to prevent the circulation of bearing currents must not be allowed to deteriorate and safety devices must be kept in operating condition.

If conditions warrant, the exceptions noted in the opening paragraph can be practically eliminated. Lightning arresters or surge protectors can be installed to safeguard individual equipment. Enclosures piped for CO_2 or fire extinguishing compound under thermostatic control at least will greatly reduce damage from fire. Proper drainage, stop-logs and sump pumps may prevent flooding. Protective devices can be developed to guard against any conceivable abnormal operating condition.

With electrical equipment meeting all these requirements for satisfactory service, what must be done and what facilities will be required to maintain it and to anticipate failures?

Designs sometimes may be modified to meet changed operating conditions. It is generally unwise to attempt such alterations except on advice of the designers of the equipment. Usually it will be found most satisfactory to have major changes made in the manufacturer's plant or by the service department maintained by the manufacturer. Almost always special tools or facilities will be required for such operations, and workmen with experience or specialized training will do the best work in the shortest time.

Suitable slings should be available for handling heavy apparatus. A wide belt sling or saddle will be found very useful in suspending direct-current armatures from a crane or hoist and there is less danger of damaging the windings or commutator with this than with a rope sling around the shaft ends. Direct current armatures and synchronous motor or a-c. generator rotors should be supported by the shaft ends on blocks, horses or racks. They should not be placed on floors or benches, as windings, commutators or collectors may be injured. A selection of eye bolts and lifting hooks will be found very convenient, and their availability will lessen the tendency to use methods or devices that are likely to damage windings and result in electrical failures.

If there are indications that conditions at the location of the apparatus have become dangerous, immediate action should be taken to eliminate any possible cause of trouble. A competent inspector with a reliable temperature indicator and in some instances an indicating hygrometer will anticipate failures caused by location faults.

An experienced engineer or mechanic is required to align the various parts of rotating electrical apparatus, or to align such apparatus to driving or driven apparatus or equipment. Shaft deflections, temperature conditions, the character of the driving or driven apparatus and many other things must be taken into consideration if satisfactory results are to be secured. The equipment used may vary from a piano wire, inside micrometers and a spirit level to the most accurate civil engineering levels and cross-hair targets.

When aligning horizontal, coupled apparatus, it is becoming the rather general practice to obtain the final alignment with thickness (feeler) gauges at the coupling. This is a particularly efficient method of aligning what are termed three bearing units. The coupling is opened slightly, one end of the rotor of the single bearing element being supported by the

spigot fit which must not be entirely disengaged. The space between the half couplings is then measured with a thickness gauge at four places 90 degrees apart. The rotating element is then turned 180 degrees and measurements are made again. Then rotate 90 degrees, then 180 degrees, repeating measurements each time.

A dial test indicator (truth gauge) located close to the end bearing should detect any tendency of the shaft to shift in the bearing clearance, although except in extreme cases this will not affect perceptibly the alignment indications.

The balancing of electrical apparatus has been called an art. Unquestionably, it is too complicated an operation for the uninitiated to attempt. The beginner should start with small, slow-speed rotors.

There are two types of mechanical balancing operations: static and dynamic. Static balancing is done on knife edges or "ways." For greater accuracy, rings having an inside diameter about twice the diameter of the journal are placed around the shaft. The equipment required is costly, as the ways and rings must be mirror polished and true to within a small fraction of one thousandth of an inch. Temporary weights first are installed. These are then removed, weighed and replaced by permanent weights which are trimmed when final balancing is done.

Dynamic balancing, as the term implies, is a running balance operation. In the field this is done in the permanent bearings. A satisfactory balance sometimes may be obtained by marking the shaft. However, experience and skill on the part of the operator and usually considerable time are required to accomplish this, particularly when high speed rotors are being balanced—that is, rotors that operate above their so-called critical speed. Generally, instruments are used in dynamic balancing operations. These vary from the dial test indicator (preferably scaled to .0001 in.) to very delicate and elaborate electronic devices. In the manufacturing plant, dynamic balancing consists of two operations: one on a complicated dynamic balancing machine and the other a running balance at full speed.

The correct connecting and adjusting of electrical equipment is, with rare exceptions, the result of following the drawings and instructions provided by the manufacturer of the equipment. It is surprising how often drawings, diagrams, instruction books and instruction cards sent with the equipment are lost or misplaced. The electrician or wireman who proceeds without such information is taking a chance that may result in trouble—he is not anticipating failure.

Beside the wireman's regular tools, certain instruments are desirable. A lighting outline is almost indispensable and a compass is frequently very useful. Portable voltmeters and ammeters always should be available and instrument transformers may be required. A combination portable instrument set like that illustrated in Figure 2 will be found very convenient.

Approved methods of operation generally are explained in the manufacturer's instruction books. There may be unusual conditions that require special consideration, but these should be carefully explained to the design engineers, and modified or supplementary instructions should be provided.

Although temperature indicators may disclose overloads, it is often worth while to get an accurate picture of load conditions. A portable graphic wattmeter or ammeter is ideal for this purpose. An indicating wattmeter used with the voltmeter and ammeter previously mentioned will establish the power factor, and, of course, the voltmeter will indicate the voltage. The ammeter or the voltmeter may be used to detect single-phase operation. Automatic synchronizers are in rather general use and such devices as voltage regulators, float switches, pressure regulators, speed regulators and automatic cutouts are installed to anticipate failures under all kinds of conditions.

Maintenance is based on inspection. The condition of electrical equipment in active service is a responsibility not only of the department or individual making periodic inspections but of the machine operator or attendant as well. A regular cleaning schedule is not always sufficient. Electrical equipment should be cleaned when it gets dirty, and dried immediately if it gets wet.

Dry compressed air at about 50 pounds pressure is helpful in removing loose dirt from the inside of apparatus. Dirt blown out of one machine is likely to be drawn into others that are running unless special precautions are taken. A suction cleaning arrangement is very much to be preferred but also is usually difficult to apply. Cleaning with cloths is the method most generally used to remove dirt from windings and if the dirt contains oil or grease this is about the only practical method.

Fig. 2—A compact kit of meters in-built with a carrying case facilitates speed and accuracy in industrial testing.

Sometimes it is necessary to use solvents to remove oil or grease and in such cases extreme care should be taken to prevent injury to workmen or damage to apparatus and equipment. Many solvents are highly inflammable and some are even explosive. Some are decidedly toxic and most of them will cause serious discomfort to workmen if used in unventilated enclosure. The fumes from carbon tetrachloride, for example, are heavier than air and present an extreme

hazard to men working in pits under machines that are being cleaned with solvents compounded with that fluid. There should be good ventilation (forced air is desirable) around apparatus that is being cleaned with solvents and one man never should be permitted to work alone.

The insulation of electrical equipment may be dried by one method or a combination, or several different methods. Small apparatus generally can be most efficiently dried in an electric oven. Steam heated and

Fig. 3—Full magnetic single motor paper machine contactor with electronic speed regulator. The protective features including overload relay, sequence interlocks as well as meters permit safe operation of the complete equipment.

hot air heated drying ovens have given very satisfactory service. An oven for drying insulation always should be ventilated. For temporary use, a wood box thoroughly lined with asbestos and equipped with electric heaters will be found very satisfactory. Large rotating type apparatus may be dried by the short circuit method (if it can be rotated), by current passed through the windings or by external heat.

Short circuit drying is usually costly and generally it is done when the apparatus might be in commercial operation. With some classes of apparatus—synchronous condensers, for example—it is difficult to apply.

Drying by passing current through the windings is likely to be either a long process or a dangerous one.

Drying electrical equipment by external heat, using electric heaters, is generally the safest and the most efficient method. As usually applied, it consists essentially of keeping the equipment dry; for electric heaters may be placed around apparatus as soon as it is received at the plant or whenever it is taken out of operation if conditions are bad, and no time will be lost in drying and the expense will be very low.

Many large water-wheel driven generators are equipped permanently with electric heaters, and it is a frequent practice to equip mill motors with electric space heaters arranged to be cut in circuit when the motor circuit breaker opens.

The modern tendency is to keep apparatus dry rather than to let it accumulate moisture and then dry it out.

A megger and a millivoltmeter supplemented by the instrument set generally will suffice as testing equipment for maintenance work. It should be understood that megger readings in themselves are not accurate indications of dielectric strength. Comparative readings, however, give an extremely valuable indication of the condition of the insulation. For example: A decidedly lower reading than one previously secured will indicate some abnormal condition and should call for an immediate investigation.

It is material rather than equipment that most interests the maintenance organization. Extra bearings, brushes, contacts and other spare parts should be available and various kinds of insulation, also insulating paints and varnishes should be at hand to take care of emergencies or to re-condition electrical equipment that tests and good judgment indicate should be taken out of service.

Not infrequently attention is called to electrical equipment that has been in service for thirty-five years or even longer. Obtaining repair parts for this old apparatus has become quite a problem. How many who read this remember when copper lead brushes were supplied with alternating current generators, or alternators? Nevertheless orders for such brushes still are received by the manufacturers of those old machines. Electrical equipment was treated with proper consideration at the time they were installed—in fact generators and motors were usually named, not numbered, in those days. Some of the old-time electricians are still carrying on, and the apparatus in their care has demonstrated beyond question that electrical equipment failures can be anticipated.

◆ ◆ ◆

Heat Wasted by Open Doors

In any large industrial plant it is worth while to give some thought to the methods of opening and closing large shop doors, especially those frequently used. The infiltration of cold air at such doors is a large source of heat loss in winter. For the passage of motor-operated vehicles, a door operated by electricity or compressed air, which can be opened and closed by the driver without leaving his seat, works out well Doors through which locomotives enter are necessarily large and present a real problem in keeping them tight, especially at the track level. A notice devised by C. C. Wilcox and designed to arouse thought when posted near large shop doors reads as follows: "HORSEPOWER OF A DOOR sounds funny but do you realize that in cold weather it takes 1½ tons of coal an hour or 600 boiler horsepower to supply the heat lost through a large shop door if it is left open? *Think! Save!*"

The Theory of Pulp-Washers

W. B. VanARSDEL, Research Department
Brown Company

THE washing of pulp is merely a special case of an important unit process which is common to many branches of chemical industry; Walker, Lewis and McAdams[1] call it "Absorption and Extraction." Analogous special applications of the process are found in distillation and rectification, the scrubbing of gases, the refining of petroleum, and the leaching of tanbark, metallurgical cinder or lime sludge. A most voluminous literature has grown up about certain of these special subjects, but the one which immediately concerns us has received little attention, and the special circumstances of the case are sufficiently distinct to warrant separate treatment.

Successive dilution and draining in a single tank or vat was undoubtedly the earliest practical method of washing pulp, and it is still in use in some mills; a sort of continuous dilution and leaching is also common practice in paper mills through the use of a wire-covered washer-drum in the beater. The fundamental mathematics of batch extraction were thoroughly studied by Hawley.[2] Griffin, in 1919[3] suggested the screw device which was later put on the market as the "screw press." A few years earlier, Sutermeister[4] had pointed out that the wet machine makes an excellent washer, and had presented some data on its performance. One extension of this idea was the continuous vacuum filter. Morrison[5] and Noble and Backus[6] have published some results on the use of these filters for washing pulp.

In any continuous transfer of matter or energy from one phase to another, the counter-current principle has long been known to be advantageous. Its application

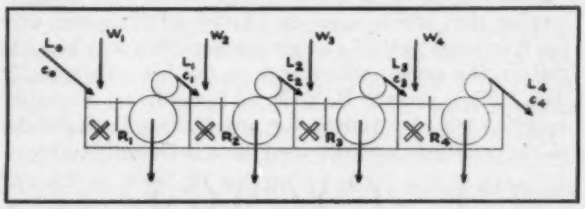

Fig. 1—Four-effect simple washer

to continuous extraction has been analyzed by Lewis,[7] by Silberstein,[8] and by Baker,[9] and a few laboratory experiments in the counter-current washing of pulp were described by Cash.[10]

Consideration of the theoretical possibilities, and of the apparatus which has actually been used for washing pulp, suggests that two distinct principles may be recognized; they might be characterized most simply as washing by displacement and washing by successive dilution and thickening. Practical washers may involve both to some extent, but the continuous vacuum filter, with wash-water applied to the surface as a spray, comes measurably close to embodying the displacement idea, while the wet-machine washer operates almost purely on the dilution principle. As a matter of theory, it may be doubted whether there is a hard and fast demarcation, and whether the distinction is not mostly a matter of convenience. In the present study only the "dilution and thickening" method will be considered, as exemplified by the wet-machine type of washer. Certain well-known principles will be applied to the derivation of formulas for the design of equipment and for the interpretation of experimental tests; the purely engineering aspects of design, however, properly belong in a separate series of articles, and will not be included here.

The Simple Washer

The wet-machine is essentially a cylinder paper-machine, specially designed to deliver a rather thick sheet. It is frequently used to form pulp into "laps" for temporary storage, by allowing the sheet to build up a number of layers on the couch-roll, then quickly slitting the soft, moist blanket, tearing it away from the newly forming sheet, and folding it into convenient compass. When the wet-machine is used as a washer, comparatively thick stock delivered to the head-box is diluted with water or white-water, and the sheet picked up by the couch-roll is doctored off as it is formed. Thus any soluble impurity which is carried with the stock entering the machine is diluted in the vat, and a considerable fraction of the diluted solution is removed from the stock by the filtering action of the cylinder.

Two types of cylinder washer are in use, and sometimes both are in use on a single machine. The wet-machine type just described does not permit of very heavy pressure being applied to the couch-roll, otherwise the sheet will crush and will refuse to pick up; on the other hand, at low pressures a wire-covered cylinder of high water-handling capacity may be used. High densities of out-going stock may be obtained with some sacrifice in capacity for removing water, by using a stiff perforated sheet as the roll covering, turning the roll in the opposite direction in the vat, and discharging the stock on a doctor-blade directly after passage under the upper roll, which is then simply a press-roll.

The removal of solute by one or more simple washings of this kind is theoretically easy to calculate. Figure 1 is a diagram illustrating four washers in series; thickened stock from each couch-roll is delivered into the dilution-vat of the next effect. Analysis of this and all similar problems is greatly simplified by reducing all quantities to common terms—best to the basis of unit weight of bone-dry pulp. Thus, if the machine delivers 100 lb. of 20 per cent dry stock in a certain length of time, the "wetness" of that stock is 4 lb. of water per pound of dry pulp $\left(=\frac{100-20}{20}\right)$; if the consistency in the vat is 2 per cent, the "wetness" at that point is 49 lb. per pound $\left(=\frac{100-2}{2}\right)$; and if during that same length of time 800 lb. of dilution water has been added, that may be expressed as 40 lb. per lb. $\left(=\frac{800}{100\times 0.20}\right)$. Now if concentrations of solute are always

expressed as proportion by weight $\left(\frac{\text{Percentage}}{100}\right)$, then the product of "wetness" and concentration at any point will give directly the weight of solute at that point, per pound of dry pulp. No question of the specific gravity of solutions arises. This convention will be adhered to throughout the present paper.

In the ideal case of perfect mixing and no specific adsorption effects, the solution in the vat will be a complete mixture of the water and of the more concentrated solution which enters with the stock; and the white-water drained from the cylinder, and the solution carried by the stock on the couch-roll, will both have this same concentration. Then a simple material balance shows that if L_o is the wetness of stock entering, and c_o the concentration of solute in the solution accompanying it, if W_1 is the weight of wash-water added, if R_1 is the wetness of stock in the vat, and if L_1 is the wetness of stock delivered by the couch and c_1 the concentration of solute in the solution carried with it,

$$R_1 = L_o + W_1, \quad \ldots\ldots (1)$$

$$R_1 c_1 = L_o c_o, \quad \ldots\ldots (2)$$

$$c_o = c_1 \frac{R_1}{L_0}, \quad \ldots\ldots (3)$$

Similar considerations would give an analogous relationship for each effect in a series of such washers when fresh wash-water is added to each vat, and the white-water from each cylinder is discarded—i. e., in such a washer as is commonly used simply to remove soluble impurities from the stock. Then using analogous expressions for the effects following the first, we have:

$$c_1 = c_2 \frac{R_2}{L_1}, \quad \ldots\ldots (4)$$

$$c_2 = c_3 \frac{R_3}{L_2}, \quad \ldots\ldots (5)$$

etc.

If these expressions are combined,

$$\frac{c_o}{c_n} = \frac{R_1 R_2 R_3 \ldots R_n}{L_o L_1 L_2 \ldots L_{n-1}}, \quad \ldots\ldots (6)$$

and the proportion of solute removed from the stock,

$$\frac{L_n c_n}{L_o c_o} = \frac{L_1 L_2 L_3 \ldots L_n}{R_1 R_2 R_3 \ldots R_n}, \quad \ldots\ldots (7)$$

For instance, in a three-effect washer of this kind, if 4 per cent stock enters (L_o—24.0), and the accompanying solution contains 10 per cent of a solute (c_o—0.10), and if each of the vat consistencies is 2 per cent (R_1—R_2—R_3—49.0) and each of the couch densities 9 per cent (L_1—L_2—L_3—10.1) then in the ideal case the washer should perform as follows:

Conc. of solution accompanying washed stock,

c_3—0.00209—0.209 per cent.

Removal of solute from stock,

$\frac{L_3 c_3}{L_0 c_0}$ — 0.0088, or 99.12 per cent removal.

The Efficiency of a Washer

It is safe to say that such performance as is predicted by these simple equations is never actually realized; in poorly-designed systems there may be much less than the theoretical removal of solute. The cause of the discrepancy may be adsorption of the solute by the fiber, insufficient mixing of the diluting liquid with thickened stock, or insufficient time of contact to permit diffusion processes to reach equilibrium. Vigorous agitation of the diluted stock in the vat is advantageous in the reduction of the latter two causes of inefficiency, but may be unable to diminish the adsorption effect.

Whatever the cause of departure from the theoretical performance, the result is noted in a failure of the washer to reduce solute concentration as far as might be expected. The degree to which it does attain theoretical performance properly may be called its efficiency. Among the various ways of translating this concept into quantitative terms, the one which appears to be most useful is an expression for the number of perfect washer effects which, under the same conditions, would theoretically give the observed performance; then the ratio of the number of theoretical effects (which may be designated E. T. E., "equivalent theoretical effects") to the number of actual effects is one possible definition of efficiency.* This is quite analogous to the method of considering distillation and rectification problems which is now quite generally used.

Suppose that the last effect of a three-roll washer were replaced by an unknown number, z, of perfect effects, each with a vat-density of R_3 and each except the last one with a roll-density of L_2; then equation (6) shows that:

$$\frac{c_2}{c_3} = \left(\frac{R_3}{L_2}\right)^z, \quad \ldots\ldots (8)$$

This relation may be assumed to hold even if z is a fractional number less than unity, so that if c_2 and c_3 are the observed concentrations with the stock entering and leaving that effect, equation (8) solved for z will give the fractional part of a single perfect effect which would deliver the same performance as the last roll actually does. Then z is the E. T. E. of that effect. A similar equation may be written for any other roll, and if all of the equations are combined for a three-roll washer,

$$\left(\frac{C_0}{C_3}\right)_{\text{obs.}} = \left(\frac{R_1}{L_0}\right)^x \left(\frac{R_2}{L_1}\right)^y \left(\frac{R_3}{L_2}\right)^z, \quad \ldots\ldots (9)$$

For the washer as a whole, then,

$$\text{E. T. E.} = x + y + z, \quad \ldots\ldots (10)$$

In the foregoing example, suppose the following data were actually taken:

c_0—0.100	R_1—R_2—R_3—49.0
c_1—0.055	L_0—24.0
c_2—0.0140	L_1—L_2—L_3—10.11
c_3—0.00386	

Then x—0.836, y—0.867, z—0.816, and E. T. E. for the whole washer—2.519; three actual effects would be doing the work that would be expected of 2.5 perfect effects, and the efficiency of the washer might be stated as 84 per cent.

(*) For this concept of efficiency and for many other valued suggestions during the preparation of this article, the author is indebted to G. A. Day, Brown Corporation, La Tuque, P. Q.

The Counter-Current Washer

The counter-current principle in washing is simply the arrangement of apparatus so that fresh water enters the last, or weakest, effect, flows in succession from that to the strongest effect, and leaves the system comparatively rich in dissolved solute. Theoretically, the system then approaches as a limit the "displacement" type

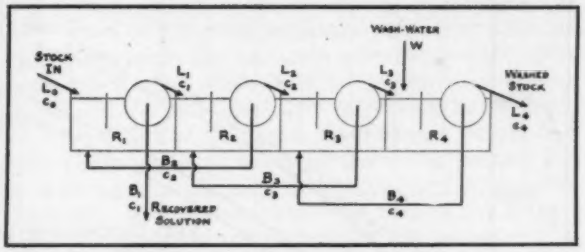

Fig. 2—Four-effect Ideal counter-current washer

of washing, with solution leaving the first effect very nearly as strong as the solution which enters with the stock. Unless there is a distinct value in the recovery of strong solution, there is no point in operating a counter-current system; as a pure washer such a system is relatively ineffective.

Counter-current extraction has been analyzed by several writers, [7], [8], [9], but the postulated system has been so idealized that it cannot be realized in washing pulp. Figure 2 illustrates such an idealized system. It will be observed that every change in the volume of wash-water used changes the consistency of the stock in all the vats correspondingly, a consequence which imposes a high degree of inflexibility on the system. The theoretical performance of such a washer, however, may be calculated as follows:

Assume a four-roll washer, as in Figure 2; stock enters No. 1 effect at a wetness of L_0 and carries solution of concentration c_0; stock is delivered by the couch-rolls at successive wetnesses of L_1, L_2, L_3 and L_4, and the corresponding concentrations are c_1, c_2, c_3 and c_4; a quantity of wash-water W is added to the No. 4 vat; the quantity of white-water flowing from No. 4 roll to No. 3 vat is B_4; from No. 3 roll to No. 2 vat is B_3; from No. 2 roll to No. 1 vat is B_2; and strong solution recovered from No. 1 roll is B_1. In a perfect washer, the concentration of B_1 will be c_1; of B_2 will be c_2; of B_3 will be c_3; and of B_4 will be c_4.

From quantity balances:

$$B_1 = L_0 + W - L_4, \quad \ldots\ldots (11)$$
$$B_2 = L_1 + W - L_4, \quad \ldots\ldots (12)$$
$$B_3 = L_2 + W - L_4, \quad \ldots\ldots (13)$$
$$B_4 = L_3 + W - L_4, \quad \ldots\ldots (14)$$

From solute balances:

$$L_3c_3 = B_4c_4 + L_4c_4, \quad \ldots\ldots (15)$$
$$L_2c_2 = B_3c_3 + L_3c_3 - B_4c_4, \quad \ldots\ldots (16)$$
$$L_1c_1 = B_2c_2 + L_2c_2 - B_3c_3, \quad \ldots\ldots (17)$$
$$L_0c_0 = B_1c_1 + L_1c_1 - B_2c_2, \quad \ldots\ldots (18)$$

Substituting and simplifying:

$$c_3 - c_4 = c_4\frac{W}{L_3}, \quad \ldots\ldots (19)$$

$$c_2 - c_3 = c_4\frac{B_4W}{L_2L_3}, \quad \ldots\ldots (20)$$

$$c_1 - c_2 = c_4\frac{B_3B_4W}{L_1L_2L_3}, \quad \ldots\ldots (21)$$

$$c_0 - c_1 = c_4\frac{B_2B_3B_4W}{L_0L_1L_2L_3}, \quad \ldots\ldots (22)$$

From solute balances taken in different order:

$$L_2c_2 = B_3c_3 + L_4c_4, \quad \ldots\ldots (23)$$
$$L_1c_1 = B_2c_2 + L_4c_4, \quad \ldots\ldots (24)$$
$$L_0c_0 = B_1c_1 + L_4c_4, \quad \ldots\ldots (25)$$

Again substituting and simplifying:

$$\frac{c_3}{c_4} = \frac{\frac{B_4W}{L_3L_4} - 1}{\frac{W}{L_4} - 1}, \quad \ldots\ldots (26)$$

$$\frac{c_2}{c_4} = \frac{\frac{B_3B_4W}{L_2L_3L_4} - 1}{\frac{W}{L_4} - 1}, \quad \ldots\ldots (27)$$

$$\frac{c_1}{c_4} = \frac{\frac{B_2B_3B_4W}{L_1L_2L_3L_4} - 1}{\frac{W}{L_4} - 1}, \quad \ldots\ldots (28)$$

$$\frac{c_0}{c_4} = \frac{\frac{B_1B_2B_3B_4W}{L_0L_1L_2L_3L_4} - 1}{\frac{W}{L_4} - 1}, \quad \ldots\ldots (29)$$

The corresponding equations may be written for any other number of effects by analogy with these symmetrical forms, since the method is quite general. Other combinations of the same original balance-equations will throw the result into different algebraic forms, but the appearance of the continued products in equations (26) to (29) makes this form particularly convenient for the following discussion.

It will be observed that if the stock densities are the same in the stock entering the washer and on all of the couch rolls, so that $L_0 = L_1 = L_2$, etc., equation (29) reduces to the following form, equivalent to that deduced by previous investigators:

$$\frac{c_0}{c_4} = \frac{\left(\frac{W}{L}\right)^5 - 1}{\frac{W}{L} - 1}, \quad \ldots\ldots (30)$$

Now in an actual washer, the performance of a given number of effects can be imagined to be replaced by the performance of a smaller number of ideal effects, just as was done in the discussion of the efficiency of a simple washer. Consider equation (26); if d = the number (actually fractional) of perfect effects, all except the last with a couch-density of L_3, which would give the same performance as the actual effect,

$$\left(\frac{c_3}{c_4}\right)_{obs.} = \frac{\left(\frac{B_4}{L_3}\right)^d \frac{W}{L_4} - 1}{\frac{W}{L_4} - 1}, \quad \text{.....(31a)}$$

Similarly, if c = the number of perfect effects, all except the last with a couch-density of L_2, which would be equivalent to the actual third effect,

$$\left(\frac{c_2}{c_4}\right)_{obs.} = \frac{\left(\frac{B_3}{L_2}\right)^c \left(\frac{B_4}{L_3}\right)^d \frac{W}{L_4} - 1}{\frac{W}{L_4} - 1}, \quad \text{.....(31b)}$$

Extend this procedure to the other two effects:

$$\left(\frac{c_1}{c_4}\right)_{obs.} = \frac{\left(\frac{B_2}{L_1}\right)^b \left(\frac{B_3}{L_2}\right)^c \left(\frac{B_4}{L_3}\right)^d \frac{W}{L_4} - 1}{\frac{W}{L_4} - 1}, \quad \text{.....(31c)}$$

$$\left(\frac{c_0}{c_4}\right)_{obs.} = \frac{\left(\frac{B_1}{L_0}\right)^a \left(\frac{B_2}{L_1}\right)^b \left(\frac{B_3}{L_2}\right)^c \left(\frac{B_4}{L_3}\right)^d \frac{W}{L_4} - 1}{\frac{W}{L_4} - 1}, \quad \text{.(31d)}$$

The fractional exponents a, b, c, d, are the "E.T.E." for each effect in the washer, and their sum gives "E.T.E." for the washer as a whole. In these equations the "observed concentrations are those of the solution carried with the stock, not the concentrations in the white-water.

The concentration of strong solution recovered from the actual washer is not equal to c_1, as it would be in a perfect washer, but is something lower than that. In other words, adsorption and imperfect mixing give on each roll a white-water which is lower in concentration than the solution which is carried by the pulp on the couch. The concentration of recovered solution may be calculated from an overall solute-balance, as follows:

$$c_r = \frac{L_0 c_0 - L_4 c_4}{B_1}, \quad \text{.....(32)}$$

Alternatively, this solution may be regarded as the discharge from the first roll of the hypothetical perfect washer, which has fewer effects than the actual washer, and its concentration may be calculated as the c_1 of the hypothetical washer.

Solute Removal Vs. Recovery

The purpose of a counter-current washer is to remove the solute as completely as possible from the fiber, and at the same time to recover a solution which is diluted as little as possible, and therefore the performance of any given arrangement is best visualized by plotting removal against dilution—for instance, the ratio c_4/c_0 against the ratio c_1/c_0. Figure 6 gives several such curves, including one for a four-effect idealized washer of the type just described. For the sake of simplicity, stock is assumed to enter the washer at the same consistency as is delivered by each of the four couch-rolls, and efficiency is assumed to be 100 per cent. Inspection of the curve shows that in such a four-effect washer, spent liquor may be recovered at two-thirds of the original concentration only by permitting the loss of 10 per cent of the solute with the washed stock; and that if this loss is reduced to 1 per cent (by suitably increasing the flow of fresh water) the spent liquor will

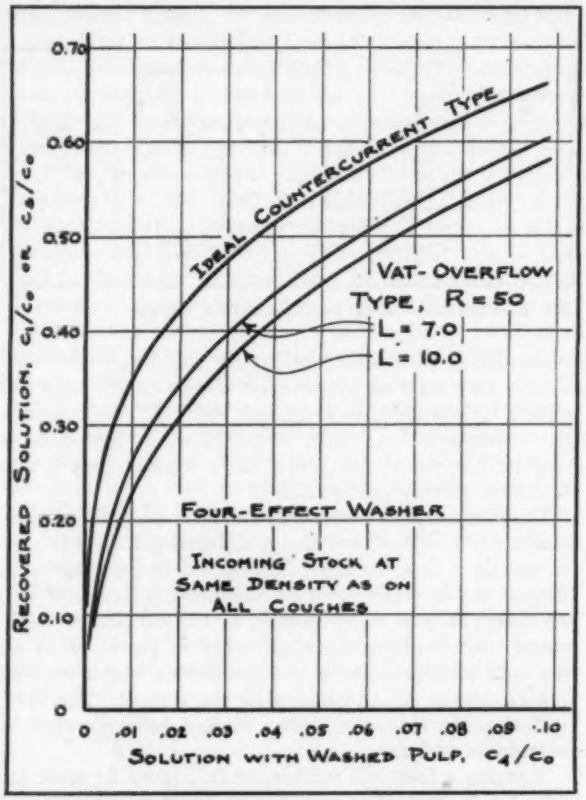

Fig. 6—Dilution vs. removal in four-effect washer. Ideal counter-current and reservoir-overflow types

be only 35 per cent as strong as that entering the washer. This performance may be improved, as will be shown later, by increasing the number of effects in the washer. It should be remarked that this type of washer is so inflexible that parts of this curve would be practically unrealizable; the limits are set by the facts that the stock cannot be much thicker than about 4 per cent in the vat, and that the couch-roll will not pick up a sheet unless it is dryer than about 6 or 7 per cent.

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Editor's Note—The second part of Mr. VanArsdel's article together with accompanying Figures Nos. 3, 4, 5, 7 and 8 will appear in an early issue of this magazine.

Animal Size for Fine Papers

FREDERICK S. KLEIN[1] and JESSIE E. MINOR[2]

THE recent survey by Holt[3] of the use of glues from animal hides for strong joinings in the days of Egyptian supremacy, and the continued use of hide glues for the same purpose over the 4,000 years intervening, speaks well for the intrinsic value of the material. Bone glues were introduced to the trade very little earlier than were wood-fibered papers and with about the same result of the indiscriminate use of the cheaper material to the detriment of high grade products. Recent technology has stressed the importance of rag papers and high grade hide glues.

Technically, the use of glue for the tub sizing of paper is parallel to that of its use for strong joinings involving the firm adherence of glue to fibers and the strong film formation by the glue alone. The development of critical testing of glue quality, as applied to paper sizing, has been slow, because the exact amount of improvement in paper strength and in the quality of the paper surface for printing and writing which may be expected from a size tub is too intimately associated with the inherent paper qualities for analysis. For this reason, there seem to be among papermakers about as many minds as to the best glue to use as there are manufacturers. Some mills buy the prepared glues, while others prefer to control the process by doing their own extraction of the raw hides.

TABLE I

Hours Cooked	Viscosity Seconds	Baumé	Ratio Visc/Bé.
8.5	39.4	1.9	20.7
9.5	44.8	2.6	17.2
10.5	47.6	3.0	15.9
11.5	50.8	3.5	14.5
13.5	73.4	4.6	16.0

One mill was led to change from prepared glue to mill-made size by an interesting experience. For some time they had been annoyed by complaints of poor matching of delicate colors in paper, even after extra care had been taken in manufacturing. A study of the glues used for tub sizing revealed the presence of excess sulphur dioxide which in loft drying was acting as a color bleach. That mill had insisted that the manufacturer furnish a very well bleached glue for color but had not checked the product for bleach residues. Another mill changed from mill-made to prepared glues because the sodium sulphide left from dehairing the hides gave sufficient black copper sulphide on the sides of tanks to allow black scales to peel off and leave discolored specks in the paper. Other mills have given up cooking because of faulty work which gave a poorer product than could be purchased.

Viscosity Test for Cooking Hides

The glue industry for years has graded glues on the series of physical tests such as jell strength, viscosity, ash, foam, grease, color, etc., but the paper industry, in the main, has tested glue sizings by Baumé only. Gradually, however, the realization that very poor grades of glue could be concentrated to give a very high Baumé without the corresponding sizing quality has led to the addition of the viscosity test as a protection against the confusion of concentration and quality possible from the Baumé test. Jell strength also might be used here for, with the purer glues, jell strength and viscosity are quite parallel, each indicating the adhesive and cohesive strength of the product but in different stages of fluidity. For less pure products, the two tests are not as parallel, but the convenience of the viscosity test makes it the more desirable for general mill work. The purpose of this article is to show by practical data the relative values of the viscosity and Baumé tests for measuring sizing quality.

Data from a first draw of a well controlled hide cooking given in Table I well illustrates the parallel increase of Baumé and viscosity with Baumé figures rising more rapidly than viscosity. The last set of figures was taken after drawing and show the excess viscosity from the mixing of bottom and top layers.

A very normal set of figures (Table II) of the cooking of two lots of domestic hides, taken from the same shipment and cooked in the same mill, the first lot by the usual routine method and the second with regulated control, indicates the losses to be expected in both quantity and quality from inadequate control. All tests were made one hour after adding alum to the lot and stirring, and figures are, therefore, directly comparable.

Thus an increase of 6 per cent in the yield from the dry hides and an increased viscosity from 8 seconds above water to 12 seconds above water (water is 32 seconds), is attained at no extra expense except that of more care in the process.

A more extreme actual case of faulty work in which the hides had been boiled all night gave a Baumé of 5 and a viscosity of 35 seconds.

The manner in which viscosity and Baumé tests may be used to regulate the time of cooking at the standard temperature is illustrated in Table III. This is also an actual mill run in which tests were made every hour for uniformity of conditions, but, for comparison in the table, only those for each three hours are given. In this table it will be seen that for the first draw the Baumé increase falls steadily and when the increase reaches 0.6 the viscosity increase also begins to fall. The data would indicate that after nine hours cooking

TABLE II

Draw Number	Per cent Yield on Dry Hides		Viscosity		Baumé	
	1st Lot	2nd Lot	1st Lot	2nd Lot	1st Lot	2nd Lot
1,	24.5	26.1	48	61	3.8	3.7
1 & 2	39.3	43.4	46	52	4.3	3.7
1, 2, 3	56.4	63.1	40	44	3.5	4.0

(1) The Hurlbut Paper Company, South Lee, Mass.
(2) Minor Laboratory, Springfield, Mass.

TABLE III

Hours Cooked	Viscosity Cooking Tub	Baumé Cooking Tub	Viscosity Increase per 3 hrs.	Baumé Increase per 3 hrs.
First Draw				
Initial	32	0		
1	34	0.5		
3	35	1.0	3	1.0
6	39	1.9	4	0.9
9	43	2.5	4	0.6
12	46	3.0	3	0.5
15	48	3.3	2	0.3
Dumped	54	3.7		
Alum 5%	61	3.7		
Second Draw				
1	40	2.0		
3	48	3.0	8	3.0
6	52	3.6	4	0.6
Dumped				
Alum 5%	52	3.7		

the solution became so dense that further extraction was slow and that the continued heating of the high grade material in solution was causing degradation. However, this high grade glue usually is used on papers that require a Baumé higher than 2.5 and, therefore, the cooking is continued to greater density, though at an actual loss of quality.

For the second draw, the softened cuttings give up their glue material quite rapidly and after six hours the saturation is at a practical maximum. When the first draw is ideally handled, this second draw material should be of better quality than the first since it does not contain the hide surface material which has been degraded by liming, etc., of previous treatment. It is the conviction of one of the authors from long observation in one mill that second-draw glues give better absorbence in the tub and better paper sizing than do first-draw glues.

In the purchasing of prepared glues, interesting information also is to be gained from the viscosity test. A study made of seven different prepared glues from three different large glue manufacturers, dissolved under identical test conditions, gave results shown in Table IV. For comparison, the data for mill-made glues dissolved under the same condition is added. The dry samples all were soaked in cold water in glass jars, then heated in water bath to 140 deg. Fahr. and tested.

TABLE IV

Viscosity	Baumé	pH	Price Cents	Ratio Visc/Prc	Ratio Bé/Price
38.4	3.8	5.8	9	3.5	4.3
41.3	3.9	6.0	12	3.4	3.2
41.6	3.6	7.6	15	2.8	2.4
44.2	3.6	6.7	17.5	2.5	1.5
47.6	3.8	7.6	20.5	2.3	1.9
53.0	3.8	5.8	18	3.0	2.1
55.0	3.9	6.6	20	2.8	2.0
60.0	3.9	5.2	14	4.3	2.8

In Table IV, two glues are offered at the same price with viscosities of 47.6 and 55 and another pair at the same price with viscosities of 44.5 and 53. The last sample in the table is a mill-made glue of average value and the price given is the calculated total cost price for making glue from hides. This sample indicates the quality that it is quite possible to maintain in making hide glues.

Data of viscosities of mill cooks collected over a considerable period of time indicated that the lots that had been cooked *less* than the chosen period of time gave on the average a viscosity higher at the same Baumé than was found for the average of the lots that had been cooked *more* than the specified time. Also, on storage of these glue sizes, the loss of viscosity per unit of time averaged less for those lots which had been undercooked than for those that had been overcooked. This again is good evidence of the importance of the careful regulation of time and temperature of cooking and that the lowest practical cooking time gives the best quality of glue.

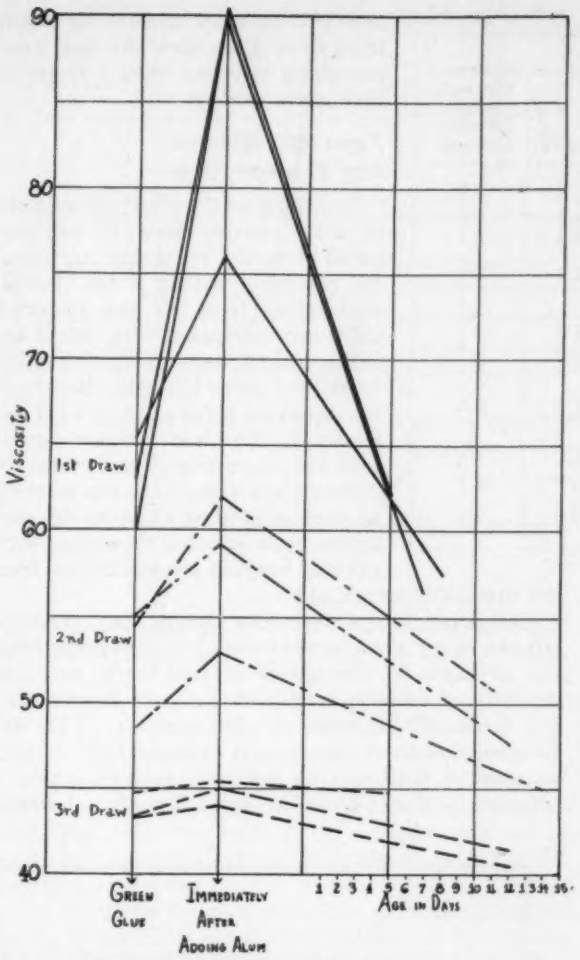
The Addition of Alum

In most mills, alum is added to the freshly drawn size in the belief that strength is increased thereby and the size is protected against putrefaction. The data of Table V and Graph I illustrate from test values the effect of this added alum on Baumé and on viscosity. For this data, tests were made immediately after drawing the size into the tub, again after adding alum and stirring to good mixing, and, lastly, after storing for one to two weeks and again softening by heating. Viscosity figures on the samples taken immediately after adding the alum were obtained with difficulty because of the high figures and the tendency towards stringiness and rapid scum formation. For this reason, the highest figures are probably not strictly accurate but do indicate the general tendency.

It will be seen from the table that the increase of

TABLE V

	When Drawn		Alum Added		After Storage		Visc. Gain from Alum	Visc. Loss from Storage
	Visc.	Baumé	Visc.	Baumé	Visc.	Baumé		
First Draw								
	63.0	4.0	89.8	4.1	56.4	4.3	26.8	6.6
	65.4	4.2	75.8	4.2	57.6	4.5	10.4	7.8
	60.0	3.9	91.8	3.9	56.0	3.9	31.8	4.0
Average	62.8	4.0	85.8	4.1	57.0	4.2	23.0	6.1
Second Draw								
	48.6	3.0	53.0	3.5	45.0	3.5	4.4	3.6
	54.2	3.4	66.6	4.0	50.6	3.6	12.2	3.6
	54.6	3.5	64.4	3.6	48.2	3.2	10.2	6.4
Average	52.5	3.3	61.3	3.7	47.9	3.4	8.9	4.5
Third Draw								
	43.6	2.7	44.0	2.7	41.2	2.7	0.4	2.4
	44.2	2.8	46.2	3.0	44.4	3.2	2.0	0
	43.6	2.6	45.0	3.2	40.4	2.7	1.4	3.2
Average	43.8	2.7	45.1	3.0	42.0	2.9	1.3	1.9



Graph 1—Effect of added alum on viscosity

viscosity due to alum is marked immediately after adding the alum, especially in the first draw where it rises to as much as 50 per cent higher than the original figures; then it drops on storage to below the original figures. This drop is partly due to the method of heating by live steam and is marked mostly for the sensitive high test material of the first draw. But the greater part of the loss must be attributed to the instability of the increase found on adding the alum.

Baumé figures seem to increase slightly on adding alum and continuously on storage, especially for the first draw, but the change is small and probably is without practical significance.

Bogue[4] notes that the initial very high viscosities of glues which have been treated with alum decline rapidly with time until they approach the initial value of the untreated glues. His chart shows, however, that while those with the most alum rose the highest and dropped the most rapidly, yet for parallel times of storage, the samples with the higher amounts of alum had the higher viscosities.

A study of the effect of alum on viscosity after storage made in this laboratory also confirms this evidence. One lot of prepared dry glue was soaked in cold water, then warmed, and to aliquot portions was added increasing amounts of alum. The temperature was thermostatically controlled at 130 deg. Fahr. and the time between adding alum and testing was kept constant. After five days of storage the samples were again heated to 130 deg. Fahr. and tested for viscosity changes. Results are given in Table VI.

In this series, the viscosity rose from 42 for the untreated sample to over 500 for the one containing about 5 per cent of alum. After storage the untreated was practically unchanged while the one with 5 per cent of alum had dropped to 21 per cent of its high value. Many of the mill storage samples of Table V had been stored two weeks and longer storage for these samples might have shown further change. However, the evidence leaves no doubt as to the tendency of rapid loss of alum-made viscosity in glue. Also, there seems to be an initial concentration of alum and glue where this enhanced value becomes conspicuous and above this initial concentration, the final values retain considerable enhancement proportional to the amounts of alum added.

As quoted by Bogue,[5] the viscosity of a glue should be at the lowest figure at pH of 4.7 and should increase with pH from 4.7 to 9.0. Plainly, the effect of alum is not one of pH change since it is in the opposite direction. It is probably enough larger than the pH effect to entirely mask that tendency and this makes pH determinations of glue of little value except for uniformity and purity of product.

An attempt to relate alum effect with alum flocculation showed that alum solutions at the pH and concentrations of the glue samples which showed large effect on viscosity showed a similar increasing series for both the flocculated alum and the aluminium ions.

The use in a mill of freshly made glue size immediately after adding alum and before stabilizing is apt to mislead by encouraging the use of too dilute a size. Irregularity in the age of such sizes is apt to give irregular drying effects in the loft. It is the opinion of some of the best size technologists that freshly made or green glues give to paper better strength and waterproofness than do stored glues. Against such recommendation, however, is the tendency to sticky paper surface and odor from putrefaction which needs extra precaution.

The Heating of Stored Glue Size

It is a common mill practice to heat a tub of stored

TABLE VI

Per cent Glue on Water	Per cent Alum on Dry Glue	Viscosity		pH Values	
		Fresh	Stored	Fresh	Stored
5.21	none	35	37	5.95	6.10
5.21	0.8	35	37.5	6.10	5.10
5.21	1.6	36	37.5	4.75	4.80
5.21	3.2	37	38	4.50	4.45
5.21	4.8	41	39	4.35	4.35
10.42	none	42	43	6.70	
10.42	0.8	43.5	46	5.45	
10.42	1.6	45.8	48	5.15	
10.42	3.2	102.2	55	4.90	
10.42	4.8	505.5	109	4.65	

TABLE VII

	When Drawn		Heated After Storage by				Viscosity Gain by Indirect Heating
			Steam		Indirect		
	Visc.	Baumé	Visc.	Baumé	Visc.	Baumé	
First Draw							
	85.0	5.0	84.8	5.1	88.6	5.2	3.8
	74.8	4.8	71.2	4.8	74.4	4.8	3.2
	71.0	4.6	78.2	4.5	80.4	4.5	2.2
	60.0	4.0	61.2	4.1	65.6	4.2	4.4
Average	72.7	4.6	73.9	4.6	77.3	4.7	3.4
Second Draw							
	53.8	3.3	53.2	3.4	64.9	3.7	11.7
	64.8	3.9	55.4	3.7	59.8	3.8	4.4
	59.2	3.8	57.2	4.0	59.0	4.0	1.8
Average	59.5	3.7	55.3	3.7	61.2	3.8	6.0
Third Draw							
	47.4	3.1	47.4	3.2	49.4	3.3	2.0
	43.0	2.4	43.0	2.4	45.4	2.5	2.4
Average	45.2	2.8	45.2	2.8	47.4	2.9	2.2

size when needed by inserting live steam into the glue, thus obtaining the maximum heating with the minimum of dilution. Such a practice must result in degradation of glue quality. To determine the extent of this degradation from this method of heating, parallel samples were taken over a considerable period of time from each tub to be heated for use and one of each pair was heated by direct steam and the other by immersing the jar in hot water. Tests were made immediately after the correct temperature had been attained and results recorded as shown in Table VII.

From this data, it is apparent that, where practical, there is a decided advantage in glue quality if the tubs are reheated with indirect instead of with live steam. This effect was to have been expected from the chemistry of glues as quoted by Holt[3] in which he says that the best glues consist entirely of proteins and "practically all attacks on the protein molecule result in hydrolysis. Acids, alkalies, *steam* and certain enzymes break down the molecule," and the decomposition products have correspondingly less jell and adhesive strength.

It is also apparent from Tables V and VII that first draw glues show the greatest gain in viscosity after adding alum and storing, while third draw glues show the least gain, increasing viscosity being a factor of high grade quality.

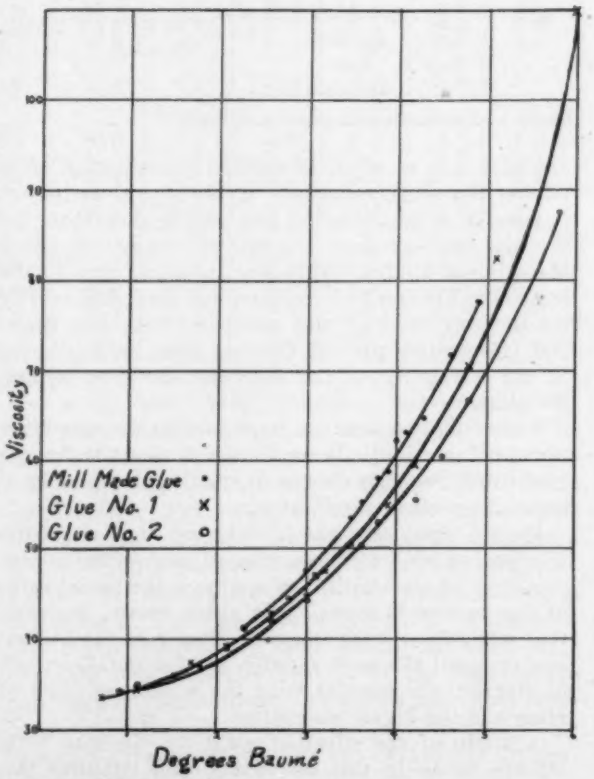
TABLE VIII

Mill Made Glue		Dry Glue Number 1		Dry Glue Number 2	
Visc.	Baumé	Visc.	Baumé	Visc.	Baumé
77.7	4.9	110.0	6.0	87.8	5.8
71.9	4.6	82.4	5.1	66.8	4.8
64.6	4.3	70.4	4.8	60.4	4.5
63.0	4.1	59.6	4.2	55.8	4.2
62.1	4.0	55.0	3.9	53.0	3.8
59.0	3.9	50.8	3.5	50.4	3.6
58.1	3.8	47.8	3.2	47.0	3.1
55.3	3.6	44.8	3.0	44.4	3.0
53.6	3.5	42.4	2.6	42.2	2.6
47.1	3.1	39.2	2.1	39.0	2.1
47.9	3.0	37.6	1.7	37.2	1.8
49.7	2.8	36.0	1.5	35.8	1.5
43.0	2.6	34.6	1.1	35.0	1.1
41.6	2.3	33.4	0.7	34.2	0.9

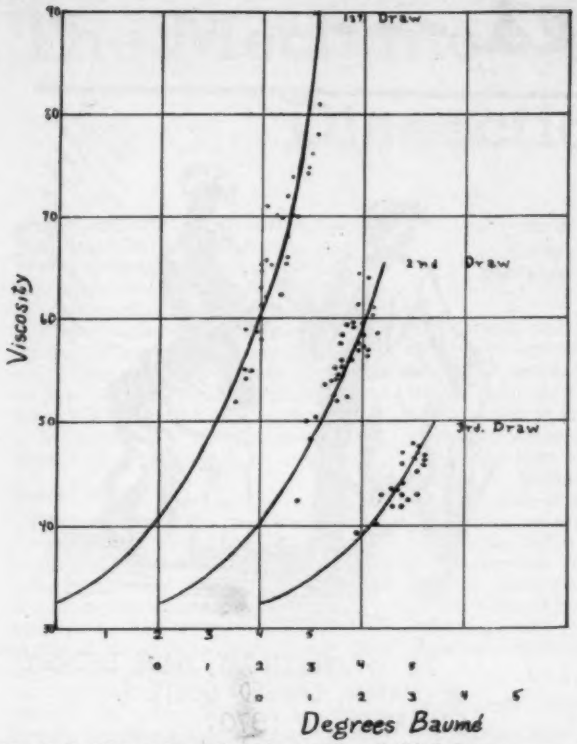
Paper Mill Glue vs. Dry Prepared Glue

As a check on the divergent opinions as to the relative merits of mill prepared glues and purchased dry glues, the results of a long series of mill-made glues from the best imported hides were compared with two of the better known best quality dry glues offered the paper industry. Results of these tests are given in Table VIII and Graph 2. The mill product figures used are the average of more than 100 different lots tested thus representing an average product while the dry glue figures were obtained by making solutions of varying concentrations from one dry lot of each kind.

The graph brings out quite clearly that, throughout the range of concentrations used in papermaking, the averages of this series of mill cooks are consistently of better viscosity at the same Baumé than are those of the prepared glue samples. This difference, though slight, is good evidence that there is no need of mill cooking giving a product which is inferior to that purchased dry. This fact becomes



Graph 2—Baume viscosity curves for mill-made and prepared glues



Graph 3—Comparison of first, second and third draws

the more interesting in view of the fact that this mill glue was prepared at an average cost of 14 cents per pound as against 20 cents or more for the best prepared glues.

An argument against mill-made glues is sometimes made from the frequent low quality of third-draw product. While this solution is weak in high grade material and has low viscosity, with careful cooking it may not be impure nor show a false Baumé enhanced by degradation products. This is shown in Graph 3 in which the data taken in one mill over a period of time is averaged for each of the three draws. The graphs are so nearly parallel as to make it quite probable that in all three cookings the relations of good glue material to degraded material are for practical purposes identical.

Summary

In the foregoing an attempt has been made to show that:

1. For properly extracted glues, viscosity and Baumé run approximately parallel, but in overcooking or with impure glues, Baumé may give misleading figures which have no relation to sizing quality.
2. The correct time and temperature for cooking each draw of glue is best regulated by the hourly changes in the rate at which the viscosity and Baumé of the solution changes.
3. In selecting a glue for purchase, viscosities should be checked against price, as different manufacturers are offering glue of widely different viscosity at the same price.
4. The addition of alum to a glue solution offers a temporary increase in the viscosity which is lost with time, especially when the storage tank is heated by live steam.
5. The large pH change caused by the addition of 5 per cent of alum on the dry weight of the glue has no appreciable effect on the viscosity of the glue size.
6. The heating of glue storage tanks indirectly instead of by the introduction of live steam into the jell, if practical, will improve the viscosity and jell strength of the size.
7. Third-draw glue is usually in a weak solution but with proper cooking it should be of as good a quality as first or second-draw products.
8. The average of figures taken from a large number of mill runs of glue cooking from hides indicates that, in the range of concentrations commonly used in paper sizing, the mill-made glue from imported hides has a slightly higher viscosity than that made from prepared glues for which the price is 50 per cent higher.

Bibliography

(3) Fred Holt, Jr., "Animal and Fish Glues," *The Paper Industry*, 17, 410 (1935).
(4) Robert H. Bogue, *The Chemistry and Technology of Gelatine and Glue*, pp. 197-198.
(5) Robert H. Bogue, *Ibid*, p. 300.

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Pulp Mills Use Tons of Stainless Steel

CORROSION has long been a problem in the pulp and paper industry, particularly in sulphite pulp mills where sulphurous acid, calcium bisulphite and organic acids have made it difficult to find materials resistant to their attack. The evolution in metals for sulphite work has progressed through non-ferrous metals, such as the acid-resistant bronzes and chemical lead, to the stainless and corrosion-resisting steels. Stainless steel has proved particularly valuable in the relief systems of sulphite digesters where hot saturated sulphur dioxide gas containing organic matter must be handled. Here stainless steels have gradually replaced other materials for all valves, fittings, thermometer wells, cover-liners, strainers, pipe or tubing, and circulating pumps for circulating systems.

The steels used for these parts are essentially the high chromium, high nickel types, sometimes with molybdenum additions. Eighteen per cent chromium, eight per cent nickel, with two to four per cent molybdenum and twenty-five per cent chromium, twelve per cent nickel are probably the most widely used analyses. A modification of this latter is a steel containing twenty-nine per cent chromium and nine per cent nickel. Greater permanence with a reduction in troublesome replacements has invariably resulted, especially where corrosive conditions of operation subject the equipment to the severest test.

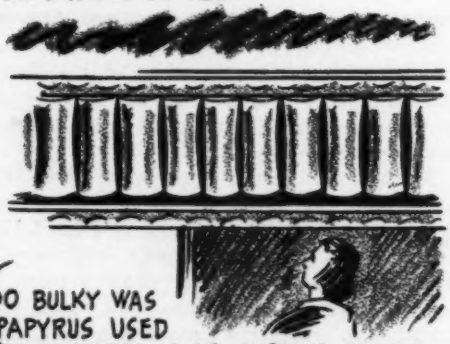
It is interesting to note that these alloys have made possible the indirect cooking method, wherein the acid is circulated during the cook through a tubular heater constructed entirely of alloy steel. Advantages obtained include greater pulp uniformity, heat economy and better control of cooking by avoiding dilution of the cooking acid by the heating steam. *(Electromet Review.)*

Paper Sketches ---

BENJAMIN FRANKLIN

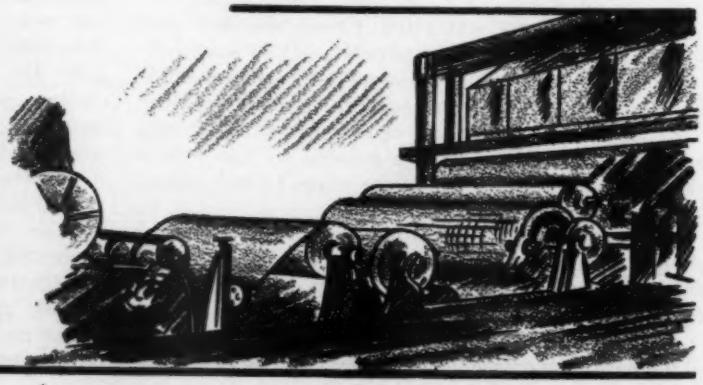
THE FOREMOST AMERICAN OF POST-REVOLUTIONARY DAYS. IN ADDITION TO ATTAINING PRE-EMINENCE IN FIELDS AS WIDELY VARIED AS STATE-CRAFT, PHILOSOPHY, INVENTION, FINANCE, PRINTING, MATHEMATICS, DIPLOMACY, SCIENCE, AND THE FINE ARTS, HE ACTUALLY FOUND TIME PERSONALLY TO PROMOTE 18 PAPER MILLS IN THE VICINITY OF PHILADELPHIA.

A 15¢ PETTICOAT, MADE ENTIRELY OF PAPER, CAUSED QUITE A SENSATION IN 1870.



SO BULKY WAS THE PAPYRUS USED BY THE ANCIENTS THAT 18 ROLLS OF THE SUBSTANCE, OCCUPYING SHELF SPACE EQUIVALENT TO THAT USED BY 18 MODERN OCTAVO VOLUMES, WERE REQUIRED TO CONTAIN OVID'S "METAMORPHOSES." TODAY WITH PAPER AND MODERN PRINTING, ONE SMALL DUODECIMO VOLUME IS SUFFICIENTLY LARGE TO CONTAIN THE ANCIENT CLASSIC IN ITS ENTIRETY.

THE WORLD'S LARGEST TISSUE MACHINE WAS PLACED IN OPERATION, NOVEMBER, 1929, IN THE MILL OF THE NORTHERN PAPER MILLS, INC., GREEN BAY, WISCONSIN. THIS MACHINE HAS A WIRE 194 IN. WIDE AND PRODUCES 10 TO 13 LB. TISSUE AT A SPEED OF FROM 700 TO 1040 FT. PER MINUTE.



The Mechano-Chemical Dissection of Wood Fibers

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University of Washington

SCIENTIFIC attempts to utilize raw material are premised upon a knowledge of the properties, behavior, and morphology of the material. Discoveries that have only academic or intrinsic interest today may lead to important industrial developments tomorrow. This condition is well illustrated in the utilization of cellulose fibers. Much has been done and much remains to be done before we can use this material most intelligently.

Earlier Work

Fiber structure has been the focus of an enormous amount of experimental work. In view of the excellent discussions available of present knowledge, it is unnecessary to review the various reports or to take up in detail the viewpoints of the various investigators. Recent comprehensive bibliographies of this literature have been cited elsewhere[1]. In order to avoid confusion, certain definitions are essential. Freüdenberg's concept and terminology of fiber structure have been adopted here as highly suitable. They are available in a single publication[1] and give a complete and chiefly accurate description of our knowledge of fiber structure from the integral fiber to molecular dimensions. Not only is his theory based on extensive and excellent original work—to which comprehensive reference is made in the article cited—but also it affords what appears to be the most convincing composite picture of fiber structure that is in general agreement with the most weighty evidence that has been produced by X-ray, crystallographic, chemical, and microscopic analysis. The nomenclature is so extraordinarily definitive that its use is peculiarly adaptable to this discussion.

Freüdenberg defines a cellulose molecule as being comprised of 100-200 glucose anhydride units. These chain molecules are like ribbons which are in bales with the surfaces parallel to each other. Adjacent bales are similarly built up and are parallel but the planes of the ribbons are not parallel. This bale, called a micelle, is the smallest morphological unit of natural cellulose and is a compact structure with dimensions of 60 Å. by 500-1,000 Å., containing 5,000-10,000 glucose units. Bundles of micelles constitute a micelle series of 600 Å. in thickness (100 micelles in a cross-section) although a micelle series is not necessarily uniform. Micelles are joined to each other in the micelle series by the interpenetration of the longer (than average) chain molecules from one micelle to another. A micelle series contains practically no lignin but is imbedded in lignin and hemicellulose. Bundles of micelle series constitute a visible fibril whose minimum diameter of 3,000-6,000 Å. is limited by the resolving power of the microscope. Freüdenberg defines a fibril, then, as a bundle of micelle series which is visible under the microscope and whose size depends on chance and the process of maceration. Micelle series in plano-parallel arrangement form lamellas of about 4,000 Å. in thickness which presumably split parallel to the micelle series to form fibrils. Lamellar aggregates, in turn, constitute the primary, secondary, and if present, the tertiary layers of the cell wall. These definitions will prevail throughout this discussion, with modifications noted below.

Experimental Data

A particularly interesting fact was revealed by Kress and Bialkowsky[2] who found that the solid material in the filtrate of beaten pulp did not reduce Fehling's solution either prior or subsequent to treatment with dilute acid. This fact has been verified experimentally by the author. With pulps and filtrates from different periods of beating in a ball-mill, no adsorption effects on the pulp or decolorization of dye solutions of Bismarck Brown, Safranin O, Methylene Blue, or Fuchsin could be detected. This same condition obtained when the adsorption of acetic acid was studied. The amounts of solid material in the filtrates of pulps beaten for various periods corresponded approximately to those found by Kress and Bialkowsky. After hydrolysis with concentrated sulphuric acid the solid material reacted positively to the alpha napthol test for glucose. Several differences, however, were apparent when the colored solution from a pulp filtrate was compared with a control solution of glucose. Pulp filtrate which was allowed to stand for two months gave no glucose reaction (bacterial action?). While a glucose solution produced a color of some permanency, the corresponding color from a fresh pulp filtrate was not quite the same in hue and faded so rapidly as to be valueless as a means for determining the extent of beating for a given pulp. When a filtrate was hydrolyzed with concentrated sulphuric acid and the sulphate ion removed with barium hydroxide, treatment with phenylhydrazine yielded the characteristic long needle-like crystals of phenylglucosazone (m. pt. 204-205 deg. C.) arranged in sheaves and three-dimensional stars which, after recrystallization from ethyl alcohol, melted at approximately 204 deg. C.

Since cellulose in a more or less colloidal state of subdivision normally would be expected to occur in a pulp filtrate, the effect of iodine solution was determined. This gave negative results. On the other hand, conceivably, cellulose micelles might be degenerated into micelle fragments, ruptured cellulose molecules, and glucose residues. The picric acid test for glucose, however, failed to demonstrate the presence of glucose. Tests with zinc chloriodine solution and attempts to precipitate the colloidal material also gave negative results. These facts pointed to an inertness of the cellulosic material suspended in the pulp filtrate.

Physical Nature of Fiber Debris

Further study promised interesting results since the inertness was hard to reconcile with existing data on pulp properties which were known to change with beating, while a study of the debris of fiber destruction offered a possible source of information regarding fiber morphology. Microscopic inspection of pulp filtrate dried upon a slide immediately made apparent that the solid material was not homogeneous. Two general types of material predominated. One consisted of the more or less angular fragmentary granules resulting from fibril disintegration, the larger particles occurring in a fairly uniform size and shape, the smaller varying in size and shape. The second type of material was a typical hydrogel of clear gelatin-like appearance, showing characteristic shrinkage cracks and occurring isolated, in part, as a ring on the periphery of the dried filtrate. This gel is shown in *a*, Figure 1; the material was stained with Methylene Blue, *a* being colorless, *b* being black, *c* dark blue, and *d* virtually unstained. The reason for the greater shrinkage and stain retention in *b* and *c* is not completely clear. The distinctness of the two types of material was accented by the fractioning effect of the filter in removing coarse material. Upon examination of the pulp itself, the same materials could be observed with the added advantage that various stages in their formation as well as points of origin could be detected.

Examination with polarized light showed that maxima and minima in luminosity in fibers were not always apparent; many crushed fibers exhibited no luminosity at all. This, of course, did not vitiate conclusions regarding the anisotropy of fibers since with sections of the thickness of a crushed fiber having the normal birefringence of cellulose, the highest interference color that could occur would be of such a low first order gray as to be indistinguish-

able from the darkness of minimum luminosity. This is illustrated in Figures 2 and 3 which are identical except that in Figure 3 the analyzer was inserted, demonstrating that the thin edges of the fiber fade into darkness even though oriented in the position of maximum luminosity. This same condition obtained with fibrils (unit fibrils, see following) and all smaller units. The clear gel was chiefly isotropic on a dry slide but occasionally exhibited inferior luminosity under crossed nicols which was probably due to strain double refraction.

Disintegration of Fibers

By studying the gradual disintegration of the fibers, interesting data were noted. As might well be anticipated, the first effect was fibrillation. When sufficient abrasion had occurred to break down the outer lateral wrapping of fibrils, the fiber, of course, disintegrated almost immediately. When fibers with one end in such a condition and the other relatively intact were dried on a slide, the fibrils, in general, regardless of origin or pretreatment, were virtually constant in size (3-4μ) and, in every case, these fibrils were imbedded in the clear gel noted earlier. This occurrence is illustrated in Figures 4 and 5. In the following, reference to the fibrils of constant diameter (3-4μ) will be made by the term, *unit fibrils*, to avoid confusion with Freudenberg's general definition of fibril size.

Further beating did not change the gel but reduced the unit fibrils in length to a conspicuously consistent average, as shown in Figures 6 and 7, with the simultaneous origin of smaller irregular fragments. Designation of the consistently regular units of the unit fibril will be made by the coined descriptive term, *cylindricoids*, so-called because the cross-section is, supposedly, approximately circular, the usually roughly plane ends are at approximately right angles to the longitudinal axis, hence, the resulting shape is nearly cylindrical, with a height of 3-4μ and a diameter of 3-4μ. Overbeating pulp as much as sixty times commercial beating, which was many hours after any apparent physical change occurred (consistency being less than 1 per cent to prevent inefficient beating due to high viscosity), demonstrated that the ultimate products of this comminution were the cylindricoids, the finer fragments, and the clear gel. It also seemed apparent that, contrary to some opinions, pulp could *not* be completely reduced—by a ball mill, at least—to a homogeneous gelatinous mass. Furthermore, the gelatinous fraction of the original pulp mass approached a limiting value which was estimated to be considerably less than half of the dry pulp. The exact quantity was not determined since no accurate method was immediately apparent. Figure 8 shows the final product of beating, a homogeneous gel and cylindricoids and fragments matted by the gel into a mass.

Fig. 1—Debris from beating. Note the clear ring of gel showing characteristic shrinkage cracks, bleached sulphite pulp, X 110

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Fig. 2—Fibrillated fiber in plane polarized light, planes of vibration of nicols parallel to the crossed lines, bleached sulphite, X 580

◆

Fig. 3—Identical with Figure 2 except analyzer was inserted

As regards fibril size, several observations worthy of note were made. As mentioned above, the diameter, regardless of source (cotton or wood), which recurred so commonly as to be considered a natural structural unit (unit fibril) was 3-4μ. Fibrils larger than this were found but usually had longitudinal splits indicative of the unit fibril. Fibrils smaller than this were also observed, but due to their infrequent occurrence, non-uniformity, and other features can probably be considered to be fragments torn from unit fibrils. These fragments of unit fibrils were usually short and had tapered ends with varying degrees of sharpness. In contrast to this, unit fibrils had approximately square ends or finely tapered ones as shown in Figure 9. The frequent recurrence and uniformity of the taper suggested that not only was it a natural condition—thus offering some evidence as to the structural unity of the unit fibril—but also would seem to indicate that the pattern of the micelle series tapered to a point, as the logs taper to a point in a cigar-shaped log raft, rather than occurring parallel to the extreme tip of the taper. Tearing or cleavage of crystalline structure would not produce such uniform and frequent tapers.

Adhesive Forces in Paper

A particularly interesting item was that the clear gel, some of which occurred alone as a ring surrounding the mass of beaten pulp dried on a slide, Figure 1, *a*, even after extended soaking in water and severe abrasion with a gritty detergent remained virtually intact. Obviously, wetting a sheet of paper bonded solely by this type of adhesion would not affect its strength. Since the strength of paper is lowered by wetting, it follows that more than one type of

adhesion occurs: that caused by a gel which resists softening, and that whose strength varies simultaneously and inversely as the moisture in the paper.

The first type is at least partially limited, apparently, by the original fiber constituents since it is not possible—within practical means—to reduce a pulp to a homogeneous gel completely, by mechanical means, and then add a suitable portion of long fibers to obtain a strong well-cemented sheet. The impossibility of this procedure is caused by the fact that the quantity of homogeneous gel that can be produced, practically, by mechanical means approaches a limiting value; the remainder of the pulp consists of fine fragments and cylindricoids which, conceivably, are composed of long cellulose molecules. As Campbell pointed out[3], the extreme length of long molecules would inhibit or prohibit capture of an "atmosphere" of water molecules while the greater total secondary valence of long molecules would resist penetration of water molecules and consequent solution.

In considering the second type of adhesion, armed with a knowledge of the first, the full force and the invaluable contributions of Campbell's crystalline bonding theory are even more apparent. No other hypothesis seems to explain adequately the strength properties of paper, in the light of the resistance of the cellulose "mucilage" to softening when exposed to water.

The relative ease of hydrolysis of the gel and the cylindricoids and fragmentary debris was determined by exposing dried beaten pulp on a slide to various concentrations of sulfuric acid for suitable periods so that the hydrolytic effects could be noted. As was suspected, the gel was more easily hydrolyzed, leaving only cylindricoids and fragmentary debris on the slide. This appears to offer an explanation of the mechanism of the increase in hydrolysis number and the relation of the hydrolysis number to tearing strength noted by Curran *et al*[4]. This also appears to be significant evidence agreeing with the inertness of the pulp filtrate as the solid matter of the filtrate consisted chiefly of cylindricoids and fragments, due to the fact that the gel was restrained by the filter. Two methods for the separation of these materials for further study were at once apparent: hydrolysis and filtration. The inertness of the cylindricoids and fragments is accounted for by the hypothesis that they are composed of longer molecules than is the gel and that, due to greater total secondary valence per molecule, the unit fibril is a more compact aggregate and hence more resistant. This view is entirely tenable when it is recalled that X-ray data on the cellulose molecule indicate the presence of 50-100 glucose anhydride units, and that this value is an *average* one; variation in the length of this molecule is more probable than unlikely. Of course, if this hypothesis be true, then the relative amounts of gel and fibril debris should be certain indicia of the relative numbers of short and long molecules present.

Fig. 4—Gel cementing fibers together, unbleached soda, X 72

Fig. 5—Unit fibrils imbedded in gel. Note frequence and uniformity of unit fibrils and cylindricoids, unbleached soda, X 300

Purely mechanical disintegration by dry beating and with a micro-manipulator gave negative results. Repeated twisting and untwisting of a single fiber failed to reveal significant information due to the fact that when the elastic limit of the fiber was exceeded, it behaved much like a piece of wire solder. When the fiber ruptured, it failed almost completely to return to its normal position. The fractured end was blunt and showed no fibril structure, although some of the lateral outer fibrils along the length of the fiber were broken during the twisting. Their loosened ends showed clearly the lateral nature of their arrangement. The nearly complete absence of fibrillation in dry beating and twisting, further substantiates the conclusion of Kress and Bialkowsky that fibrillation could not occur unless a solvent was present which could cause swelling and hydration.

Using rubber-covered milling elements a remarkably uniform bruising and loosening of fibrils was found to result throughout the length of the fibers, yet no evidence of the existence of Lüdtke's cross elements[5] was found, the fibril structure appearing to be completely continuous.

An attempt to correlate the above findings with Ritter's et al. discovery of fusiform bodies and spherical units[6] by treating the same pulps with phosphoric acid gave negative results. Perhaps, as those authors suggested, the pretreatment of the fiber has a bearing on the formation of these units.

The above experimental data were secured from bleached sulphite pulp *(Tsuga heterophylla)*, unbleached, partially bleached, and bleached soda pulp *(Pseudotsuga taxifolia* and *Populus trichocarpa)*, and surgical cotton. An endeavor to achieve freedom from chemical effects other than those induced by water was made by boiling the pulp in distilled water until neutral. Beating followed in distilled water using glass milling elements throughout, except for the substitution of rubber, as noted above. It is particularly to be emphasized that all experimental observations recorded here were duplicated with all the materials used and that statements made, apply with equal force to the different fibers, regardless of origin or pretreatment. It is of value to note that, for obvious reasons, the gel, cylindricoids, and smaller fragments were invisible in Canada balsam whose index of refraction (1.54) is approximately the same as cellulose, virtually invisible in water (n=1.33), but were easily discernible in air (n=1.00) in a rather dim

axial illumination. Staining cylindricoids, etc., for the purposes of inspection and photography gave rather negative results since the depth of color, due to the thinness of the objects, was so slight as to be scarcely detectible.

Conclusions from Experiment

A simple theory accounts for the above data: in agreement with well-accepted beliefs, fibers consist of fibrils which are oriented at a small angle to the longitudinal axis of the fiber in the

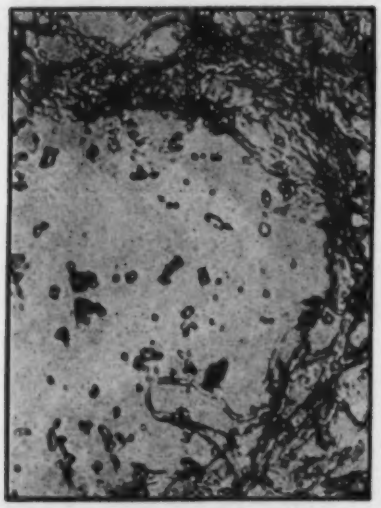

Fig. 6—Unit fibrils, cylindricoids and multiple cylindricoids. Note uniformity of the unit fibrils and compare diameter of the unit fibrils with the diameter of the cylindricoids, surgical cotton, X 780

inner lamellas and at practically right angles in the outer lamella. Comminution in water causes softening, swelling and disintegration. Fibrils appear to have a commonly recurring diameter (3-4μ). The separation of fibrils is accompanied by the appearance of a more chemically active hydrogel—cellulosic since it occurs in cotton—which seems to function as a binder or matrix for the fibrils. Fibrils larger than the unit fibril have the characteristics of an aggregate of unit fibrils; fibrils smaller than the unit fibril appear to be torn portions of unit fibrils. The disintegration of unit fibrils results ultimately in cylindricoids and finer fragments. Fragmentary debris may be explained by an analogy from mineralogy: if any crystalline material with well-developed cleavage, such as calcite, for example, is reduced to powder, it is found to consists of a few well-formed or partially formed rhombohedra together with a great deal of material which is highly irregular in shape. The significance of the cellulose cylindricoid, then, is made more striking by its common recurrence. Obviously, the debris of a structure composed of blocks laid end to end would consist of the blocks plus the finer debris resulting from torn corners and split blocks. The cause of the uniformity of the diameter of the unit fibril is not completely clear but points strongly to the presence of the matrix just mentioned. The uniformity of the height of the cylindricoids suggests that the ends of enough micelles occur at one spot to form a weak spot in the unit fibril; hence the unit fibril is a strand composed of regularly recurring units. The composite concept, then, is suggested that fibrils are composed of long molecules with the ends of enough micelles or micelle series occurring at one point to cause weakness at intervals 3-4μ apart along the length of the unit fibril. The gel-forming cellulose composed of short molecules occurs as a matrix and binds unit fibril to unit fibril to form a lamella, and lamella to lamella to form a fiber.

Discussion

A comparison of this theory with current concepts of fiber structure reveals striking similarities. Freudenberg suggested that micelles series were imbedded in a matrix of lignin and hemicellulose[4]. Lüdtke proposed a somewhat similar theory, on a grosser scale, when he enunciated his hypothesis of a skin system[5] and claimed that staining effects, permeability, solubility, etc., demonstrated the presence of lignin in the skin which corresponds, to a certain extent, to Freudenberg's matrix. The similarity of the above theory with Lüdtke's skin system is very close, and is reasonably close to Freudenberg's matrix provided that a grosser matrix be substituted or added to Freudenberg's concept. In the interest of closer agreement, however, one modification is imperative: each theory should be expanded to include cellulose in the composition of the skin or matrix. This is

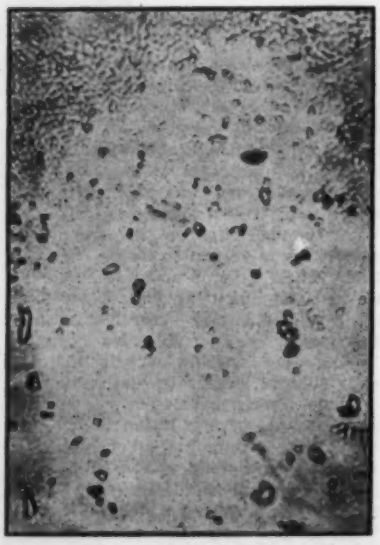

Fig. 7—Cylindricoids and multiple cylindricoids from bleached sulphite, X 680

essential due to the fact that fibers of pure cotton behave in the same manner as wood fibers. Wood fibers may, of course, also include lignin and hemicellulose in the skin or matrix, but the gel-forming cellulose is the essential constituent since it occurs in cotton, contributes to the type of disintegration characteristic of all cellulose fibers, and is the substance whose presence is essential to fibrillation. As Kress and Bialkowsky demonstrated, fibrillation can not occur unless a solvent is present which can cause hydration, so does this experiment show, by the simultaneous appearance of the hydrogel and the fibrillation, and the resistance of certain portions of the fiber to gelatination, that fibrillation can not occur unless a gel-forming cellulose is present between the unit fibrils which can hydrate and swell, releasing the fibrils from the firm matrix. The difference in the hydration capacity of the cylindricoids and of the gel may be explained by the aid of Campbell's theory of hydration[7] which states that pulp hydration consists essentially of the capture of an "atmosphere" of water molecules by each cellulose molecule, resulting in solution; in the case of long molecules this is difficult. Consequently, it is suggested that the parent cellulose of the gel, constituting the skin or matrix, is composed of short molecules and the cylindricoids of long molecules. This would explain the difference in hydration capacity, the difference in the ease of hydrolysis, the increase in the hydrolysis number with beating, and the inertness of the cylindricoids since the greater total secondary valence of a long molecule would result in a more compact and resistant aggregate. However, it is conceivable that even the cylindricoids could be reduced to a gel, achieving complete hydration—using Campbell's concept—by the action of a colloid mill.

Farr[8] recently found ellipsoid particles of cellulose in the cytoplasm of cotton, having major and minor axes of 1.5 and 1.1μ and indices of refraction of 1.565 and 1.530 respectively. These ellipsoids were closely appressed end to end to form fibrils. By means of pectic solvents these ellipsoids were demonstrated in mature fibers. Farr claimed that pectic solvents, absence of double refraction, and staining with ruthenium red indicated a pectic substance, to the extent of perhaps 1-2 per cent, in the substance cementing the ellipsoids and fibrils together, although Ritter, Harlow, and Scarth et al[9] had shown independently that pectic solvents and ruthenium red were unreliable, while the absence of double refraction proves nothing—since in this case crystalline material of the isometric system is hardly possible—except unordered molecular arrangement, which is quite as possible for cellulose as for pectin, as shown by the isotropy of the gel noted earlier and the same property in commercial cellulose films and filaments. The isolated ellipsoids swelled in sulphuric acid, producing a spherical structure—which any small particle of cellulose will do—which still exhibited double refraction, although Ritter and Seborg[6] had mentioned the possibility that the spherical units they found might have been produced by the swelling of smaller, perhaps angular objects with optical prop-

erties similar to fusiform bodies, i. e., parallel extinction as with Farr's ellipsoids. They stated also that swelling of a small angular body would probably produce a spherical structure with random molecular arrangement which would, of course, cause isotropy. In connection with the interpretation of the results obtained through the use of polarized light, it is well to bear in mind that random molecular arrangement causes isotropy and consequent *darkness* in *all* positions under crossed nicols, that depolarization of light by reflection, refraction, and diffraction at a surface becomes *marked* when the material is finely divided, and that fine material may appear bright between crossed nicols, even if isotropic. Furthermore, it is extremely difficult to understand how double refraction can be observed in a single bacterium or a cellulose particle of the order of 2μ or less in thickness with a birefringence of 0.035 since optical anisotropy is not observable if the specimens are too small, since the polarization colors are of such a low first order gray as to be indistinguishable from the darkness of minimum luminosity. Reference to a Michel Lévy table of birefringence will illustrate this. Accordingly, the minimum thickness of section with birefringence of 0.035 that can show observable anisotropy is 6-7μ. This thickness of section and birefringence would cause a difference in phase of 100$m\mu$ which equals $\frac{1}{2}$ for blue and $\frac{1}{4}$ for red light (it will be recalled that maximum luminosity is produced when the difference in phase is $\frac{1}{4}$). This minimum thickness of section was checked experimentally and found to be accurate, unit fibrils and cylindricoids failing to exhibit *any* anisotropy while aggregates

Fig. 8—Ultimate product of beating bleached sulphite. Note the gel, fragmentary debris and cylindricoids, X 350

of unit fibrils which were two unit fibrils in thickness (6-8μ) did show very faint aeolotropy. In the case of the bacterium the birefringence of the colloidal protoplasm was apparently overlooked completely.

Farr also isolated ellipsoids by mechanical means alone although the details of the procedure used are lacking. That these units are entirely different from the cylindricoids described above is apparent from a comparison of size alone, the smallest dimension of the cylindricoids being 3-4μ, the largest dimension of the ellipsoids being 1.5μ. As it is impossible, due to the limit of the resolving power of the microscope, to make accurate measurements at the magnifications required for the visual observation of these small objects, it seems valueless to attempt to correlate micelle length (500-1,000Å.) with the dimensions of the cylindricoids (30,000-40,000 Å.) since the error in measurement would be many times the length of a micelle. Farr's contention, that the optical effects obtained by the use of polarized light and usually ascribed to the orderly molecular arrangement of natural cellulose is perhaps caused by the elliptical bodies she discovered, with dimensions of 10,000-15,000 Å., rather than to submicroscopic micelles, appears to be somewhat untenable when it is recalled that these effects can be obtained with light having a wavelength of 4,000 Å.

Fig. 9—Single fibrils showing blunt and tapered ends, bleached sulphite, X 330

Summary

Beating pulp failed to cause adsorption of dyes or acetic acid. The fine material resulting from fiber disintegration was found to consist of a hydrogel and granular debris in what appeared to be definite proportions. Both were identified as cellulosic in nature. Cellulose fibers disintegrated into fibrils of a frequently recurring size and a more chemically active gel which appeared to arise from a substance forming a matrix for the fibrils. The hydrogel, which was shown to be cellulosic, formed a horny mass when dried and resisted softening almost completely when re-exposed to water. The presence of two types of adhesion in paper was shown and its significance discussed. Fibrils were reduced to cylindrical units which seemed to be laid end to end and to form fibrils, indicating, possibly, that the ends of enough micelles or micelle series occurred in one point to cause a weak spot. The fibrils of a commonly recurring size, considered to be a structural unit, had uniformly and symmetrically tapered ends which, presumably, overlapped to form a more or less continuous structure. A hypothesis is offered to explain the experimental observations; it is discussed in the light of current knowledge of fiber structure.

Acknowledgment

The author desires to acknowledge his indebtedness to the Agnes Healy Anderson Research Fellowship Fund and to the Charles Lathrop Pack Forest Education Board for the financial assistance which made this investigation possible.

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◆ Superintendents' Meeting Goes to Grand Rapids

The annual convention of the American Pulp and Paper Mill Superintendents Association, which will be held on June 24, 25 and 26, will be held at Grand Rapids, Mich., and not at Kalamazoo, Mich., according to an announcement recently made by Charles Champion, president of the association.

According to Mr. Champion, the reason for the change was due to the fact that the members of the Superintendents Association in Kalamazoo finally came to the conclusion that they could not house a convention of this size in their city due to inadequate hotel accommodation.

Mr. Champion further states that the Grand Rapids convention will have the enthusiastic support of the entire Michigan division, which will act as host at the national convention.

"Donpaco" Specially Designed Newsprint Carrier

THE November issue of *F-M News*, house organ published by Fairbanks, Morse & Company, carries a very interesting account of a record run established by the Donnacona Paper Company's specially designed newsprint carrier, the "Donpaco."

The first of its kind constructed in Canada, the Donpaco was built at the Lauzon shipyards of Geo. T. Davie and Sons, Lauzon, Quebec, from the designs of Messrs. Lambert and German, naval architects of Montreal.

The principal dimensions of the motorship are length over all—113 ft.; breadth, moulded 22 ft. 3 in.; depth, moulded 8 ft. 6 in.; draft, light 9 in. forward, 3 ft. 9 in. aft; draft loaded 6 ft. 6 in.; dead weight, 215 gross tons; registered tonnage, 201.35. She is powered with a 5-cylinder Model 35-E-10 Fairbanks-Morse direct reversing Diesel rated at 190 hp. at 375 r.p.m. The engine operates a Kennedy 3-blade bronze propeller 54 in. diameter by 36 in. pitch.

This vessel carries 335 rolls of newsprint 71 in. long by 34 in. in diameter, weighing approximately 1475 pounds each, a net cargo of 247 tons.

On her first trip, the vessel left Donnacona, 30 miles west of Quebec City, Canada, at 7:30 p.m., arriving at Port Newark at 7:30 p.m. of the fifth day following. On the return trip, she left Newark at 9:30 a.m., arriving at Donnacona at 7:45 p.m. on the fourth day. The speed of the vessel loaded, according to tests, was 12 miles an hour.

◆ World's Largest Newsprint Machine Operating

The December 13th issue of *The World's Paper Trade Review* publishes an interesting account of the first run of the new 320-inch newsprint machine at the Kemsley Paper Mills of Edward Lloyd, Ltd. It is stated when first started up, at the colossal speed of 1,400 ft. a minute, it ran for 24 hours without a break.

The machine was built by Messrs. Walmsleys (Bury), Ltd., weighs 2,000 tons and is 500 ft. long. It is the largest in the world, producing 1,200 tons of newsprint per week at a speed of 1,400 feet per minute.

The cost of the installation runs to something like a million and a half sterling.

◆ Canadian Duties on Machinery and Farm Equipment Lower

Duty rates on virtually all items of industrial machinery and farm equipment imported into Canada from the United States have been reduced under the Trade Agreement just concluded between the two countries, according to the Department of Commerce.

Normally, it is pointed out, more than half of the Canadian imports of industrial machinery from the United States are entered under Paragraph 427 in which the duty has been lowered from 35 per cent to 25 per cent, with the further stipulation that machinery under this catagory, if of a kind not made in Canada, will be dutiable at 20 per cent.

This Canadian paragraph applies to a great many of the principal classes of machinery in which the United States is interested, such as air compressors, cement making machines, ice and refrigerating machines, coal-handling machines, concrete mixers, cranes and derricks, metal-working machinery, paper and pulp-mill machinery, power pumps, power shovels, water meters, and water turbines.

Still greater reductions have been granted by Canada on equipment of certain industries which the Canadian authorities desire to foster. These special items have in some cases been put on the free list and in others accorded rates running from 5 to 15 per cent as compared with the 35 per cent which applies at present, it was stated.

The rates of duty on agricultural equipment (plows, cultivators, reapers, threshers, etc.) have been reduced from 25 per cent to 12½ per cent. Internal combustion tractors of all types and for all uses, including farm and industrial, have been placed on the free list, whereas under the present tariff law these types are dutiable at rates as high as 25 per cent.

It is believed that the new rates of duty, which become effective on January 1, 1936, should result in an appreciable improvement in United States machinery trade with the Dominion, according to the Commerce Department.

◆ Fred C. Boyce Retires

Announcement has been made by the Wausau Paper Mills Company, Wausau, Wis., that Fred C. Boyce, who has served as the company's superintendent for 31 years, retired from active service December 1st of last year.

In the summer of 1929, Mr. Boyce planned to retire and tendered his resignation effective as of July 1st. The company did not appoint a successor for a time, and in October of that year, when the depression hit the country, he was asked to return to his old duties and to lend the benefit of his long experience in the crisis of that period.

Mr. Boyce's career as a papermaker was a long one—53 years in all. After finishing his education in the public schools of Corinth and Saratoga Springs, N. Y., he went to work in the paper mill of the Hudson River Pulp & Paper Company. Here he worked for 19 years. In 1901, he went to work for the Falls Manufacturing Company, Oconto Falls, Wis., and in 1904 he entered the employ of the Wausau Paper Mills Company, Brokaw, Wis., which company he served as superintendent up to his recent retirement.

In 1919, the American Pulp & Paper Mill Superintendents Association was organized and Mr. Boyce was chosen as the first president. By reason of this service, he has been called the "Daddy of the Superintendents Association."

Although no longer actively connected with the Wausau Paper Mills Company, Mr. Boyce still retains his interest in the company. As president of the D. J. Murray Manufacturing Company, of Wausau, and vice president of the Wisconsin Paper & Products Company, of Milwaukee, Wis., he will continue to be actively engaged in these organizations.

◆ E. C. Roberts Returns to Detroit Graphite

The appointment of E. C. Roberts as vice president in charge of sales, recently was announced by the Detroit Graphite Company, Detroit, Mich.

Mr. Roberts was associated with the Detroit Graphite Company for 16 years prior to May, 1933, when he resigned as vice president in charge of sales and became associated with the Arco Company in the same capacity. Due to his former connection with the Detroit Graphite Company, Mr. Roberts is well known and recognized throughout industry for his intimate knowledge of industrial markets in which field the company deals exclusively.

◆ J. E. N. HUME, assistant manager of the General Electric Company's industrial department, has been appointed manager of the department, succeeding the late W. W. Miller, it was announced December 26 by E. O. Shreve, vice-president of the company. Mr. Hume had been assistant manager for the previous six years and in that capacity was responsible for general sales direction, policies, prices, consignments, and similar activities of the department.

Prospects for 1936

The following expectations for the coming year constitute a news release recently given to the publications in the industry by the American Paper and Pulp Association. *Editor's Note.*

THE approach of a new year invariably calls for a review of the past and a consideration of the prospects of the future. This usual practice takes on an added significance when progress in the immediate past can be reported and when the prospects in the future appear bright. Statistics and opinion agree that substantial progress in the paper industry was made in 1935 and the industry's leaders believe that the prospects for 1936 appear good.

The paper and pulp industry has been slow in recovery. The spurt of production in 1933, coincident with the enactment of the N.I.R.A., lifted the records for that year above the disastrous record of 1932. But better business was but temporary. Production declined in 1934 to low levels, particularly in July and August. From then on, however, a gradual quickening in activity took place, which carried over the year-end, showing little influence from the usual seasonal factors, and even on through the summer months, when normally sales of paper decline. Production lifted even higher in the last half of 1935, bringing the level of the industry over the year to a fairly satisfactory record.

Preliminary estimates, based upon ten months' report, indicate that the paper industry as a whole produced in 1935 approximately 10,375,000 tons of paper and paperboard. This figure represents a substantial advance over the 1934 record which was reported by the Bureau of Census at 9,140,000 tons.

During the latter part of 1935 the production of coarse paper grades responded to the greater volume of retail sales and in some grades new production levels were established. The fine paper grades do not normally respond quite as rapidly, but significant increases in sales volume took place in most instances.

The volume of paper production is closely coordinated with general business conditions. There may be some lag in the response of the paper industry to the up and down movements in industry as a whole, but over relatively long periods the coordination is close. The prospects for 1936, therefore, with practically all business advisors prophesying continued increase in the index of productivity, indicate a good year for the paper industry. This is particularly true because the volume of production in 1935 went largely into immediate consumption; there was little tendency on the part of merchants and converters to increase stocks. As a matter of fact, in most grades stocks at the year end are at their normally low point. These indications are unusually significant; so much so, in fact, that some believe production in 1936 will approach if not equal the record of 1929.

Price movements in 1935 have fluctuated through narrow ranges. Average mill realizations show little change with comparable figures for 1934. As production has increased, prices have tended to become firmer, which may well indicate a general upward movement in prices as the expected volume increases take place.

Price strengthening is justified by cost increases. Price levels have changed but little in most grades since the summer of 1933, which was before the adoption of the industry's code of fair competition. Throughout the intervening period costs of materials and of labor have increased steadily. These increases were not offset by price increases; but in 1935 their retarding effect upon profits was somewhat lessened as volume of sales grew and unit overhead costs declined. It is clear, however, that the industry has not yet attained a position of normal profit and that if costs remain at their present levels price increases, when justified by greater volume of production, are necessary for most manufacturers if they are to maintain their financial resources and their production facilities.

◆ Trimbey Machine Works Busy

Trimbey Machine Works, Glens Falls, N. Y., have reported considerable activity during the past year in the development and installation of new equipment designed and manufactured by them.

Several of the new Trimbey knotters which are stated to have large capacity for the fineness of their perforations were placed into operation. These knotters are handling both groundwood and sulphite in one of the large New York State mills. In addition, twenty-seven Trimbey screens were installed during the year for screening all kinds and grades of pulp from soda to old paper stock as delivered from a breaker beater. Numerous consistency and weight regulators also were said to be installed for the handling of various papermaking stocks from tissue to heavy kraft.

Among the other activities of the company which were reported was the perfection of a thin stock consistency regulator to control any density of stock from .2 per cent up to 1½ per cent. This machine, it is stated, will indicate and control automatically, as well as record on a chart, the density of stock going to the screens.

◆ Muskingum Fiber Products Corporation

A new company has been incorporated under the laws of the State of Ohio, to be known as the Muskingum Fiber Products Corporation.

This company will build a new strawboard plant on a 70-acre tract lying between the W. & L. E. and Pennsylvania Railroads two miles west of Coshocton, Ohio, and along the Muskingum River. It is expected building operations will begin about April 1.

When completed, the production of the plant will be 50 tons per day of .009 strawboard, together with some specialties for the corrugated trade. The machine will have a trim of 105 inches. The entire plant will be electrified with provision for making the plant's own power.

Officers of the company are: President, N. H. Carpenter; vice president, Mildred H. Carpenter; treasurer, Nathan H. Carpenter, Jr.

◆ F. C. Stamm With Armstrong Machine Works

F. C. Stamm recently resigned as general superintendent of The Upson Company, Lockport, N. Y., to become associated with The Armstrong Machine Works, Three Rivers, Mich.

Mr. Stamm has been associated with the paper industry for over 20 years. During the past five years he has taken a very active interest in the Drying Committee of T.A.P.P.I. and has presented a number of papers dealing with the subject.

The Armstrong Machine Works has recently established a special paper mill department to handle the various paper mill specialties developed by the company. One of these specialities, a moisture control for paper machines, is already on the market and will be announced to the trade in the near future.

◆ A. W. Butterworth

A. W. Butterworth, president of H. W. Butterworth & Sons Company, Philadelphia, passed away at his home in Langhorne, Pa., December 18 at the age of 67 years.

Mr. Butterworth had been identified with the company for fifty years, having served as president for the past eight years. He succeeded his brother, H. W. Butterworth, Sr., who in 1928 became chairman of the board of directors.

Surviving the deceased are his son, J. Ebert Butterworth, vice president and treasurer of the company; two brothers, Harry W., Sr., and J. Warner Butterworth; and a sister, Miss Elizabeth Butterworth.

◆ J. G. Obermier

J. G. Obermier, vice president in charge of production and Member of the Board of Directors of The Timken Roller Bearing Company, passed away in Tucson, Arizona, December 28, 1935.

Mr. Obermier was born in Cleveland, November 13, 1868, and early became interested in production problems. After working for a number of years in Cleveland, he came to Canton, Ohio, and in 1912 joined the Timken organization as superintendent of production. He was in active charge of production through the intensive development period of the company, being personally responsible for many of the plant efficiencies which have played an important part in the growth of the organization. In 1921 Mr. Obermier was elected to the Board of Directors and appointed vice-president in charge of production, which position he filled actively until within a few weeks of his death.

◆ Combination Surface and Needle Pyrometer

The Pyrometer Instrument Co., 104-109 Lafayette St., New York, N. Y., has placed on the market a pyrometer set which permits assembly in only a matter of seconds into four different types of surface and needle pyrometers. The set is designated as the new Pyro Universal set.

To change from one type of pyrometer to another simply means the interchanging of a thermocouple. Another feature of the set is the instrument indicator. This indicator is a patented clamping device which makes it unnecessary for contact and reading of actual temperatures to be made simultaneously—the indicating needle of the indicator staying fixed at the temperature indication.

The set is suggested by the manufacturer for rather wide application in many industries among which the paper industry is mentioned.

Additional information descriptive of the pyrometer set may be obtained by addressing the manufacturer.

◆ Steel Box Truck

An all-steel box truck with a smooth box interior has been announced by the Stackbin Corporation, P. O. Box 940, Providence, R. I.

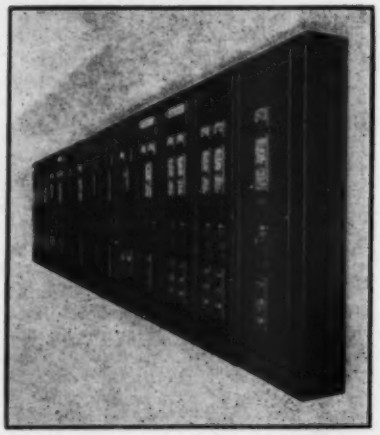
The inside dimensions of the standard box are 33 in. long by 19 in. wide by 24 in. deep. Twenty-gauge sheet steel is used for the sides and ends, and eighteen-gauge steel for the bottom. Its chassis frame is made of heavy gauge formed steel channel, on which are mounted two 3-in. swivel and two 4-in. stationary casters—the chassis being bolted into the underneath portion of the truck.

Any size of box truck of the same construction and equipped with suitable casters will be made to order by the manufacturer.

◆ "Streamlined" Switchboards

New General Electric switchboards are "streamlined" by having the devices built in, instead of hung on, the face of the panels. The new switchboards are of steel, with the instruments recessed so that they project about an inch from the front of the panel.

The new construction is being applied not only to vertical switchboards but also to benchboards, cubical doors, metal-clad front enclosures, and swinging brackets. Air circuit breakers used are of the dead-front type, with the current-carrying parts enclosed. Other devices



have been re-designed for semi-flush mounting, so that the new switchboards have a modern appearance harmonizing with smooth walls, clean floors, and machines of modern design.

◆ Anti-Freeze Fire Extinguisher

An anti-freeze type of fire extinguisher with an automatically regulated rate of discharge from the expelling cylinder has been placed upon the market by the American La France & Foamite Corporation, Elmira, N. Y.

When the extinguisher is inverted and bumped, carbon dioxide gas is released from a steel cylinder and expels the liquid. When the pressure is high, as in the early part of the discharge, the outlet from the expelling cylinder is small; when low, during the latter part

of the discharge, the orifice is larger. The self-expelling feature permits the operator to move around more freely without his attention being distracted by pumping.

The shell and dome of the extinguisher are drawn from one sheet of metal without side or dome seams.

The ultimate bursting pressure of a unit is stated to be 30 per cent higher than that of ordinary fabricated extinguishers. The charged extinguisher is said to be 10 per cent lighter in weight. Likewise, it is suggested that the extinguisher does not freeze at temperatures as low as 40 deg. Fahr. below zero and that annual recharging is not necessary.

◆ Accident-Proof Paper Cutter

A paper cutter safety device through the use of which both hands of a cutter operator must be below the cutting table to operate a cutter has been installed by the Westinghouse Lamp Company, Bloomfield, N. J. This device, which might be called a safety handle, includes a long lever on the opposite end from the handle of which is a case hardened ridge. This ridge fits into a groove on

the underside of the starting lever bushing, where it is held firmly by a close-wound spring.

The operator of a cutter equipped with such a device must lift the safety lever before he can lift the starting lever that releases the cutting blade. To perform such an operation requires the use of both hands and thereby minimizes the accident hazard.

◆ 25-12 Stainless Steel Welding Electrode

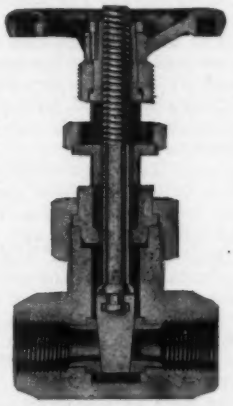
A new arc welding electrode for welding the group of stainless steels belonging to the 25-12 variety is announced by research engineers of The Lincoln Electric Company, Cleveland, Ohio. This new electrode, known as "Stainweld B," provides weld metal of the same characteristics as steel containing 25 per cent chromium and 12 per cent nickel.

In addition to possessing high tensile strength and unusual resistance to corrosion, the manufacturer states that this weld metal has high ductility and is exceptionally resistant to abrasion. Moreover, the electrode deposit is said to maintain these physical properties at high temperatures.

The electrode is available in 5/32 and 3/16-inch sizes in 11-inch lengths. It comes packed in 15-pound containers in the 5/32-inch size and 10-pound containers for the 3/16-inch size.

◆ Gate Valve With 5-Year Guarantee

The Chapman Valve Manufacturing Co., Indian Orchard, Mass., has introduced a gate valve that carries with it a 5-year guarantee. This valve, machined from solid steel bar stock and known as List 960, is made in all standard sizes from ¼ inch to 2 inches and is designed for all services up to 600



pounds pressure at 800 deg. Fahr. The ¼ inch to 1 inch sizes are designed for cold working pressures of 2,500 pounds; the larger sizes for 1,500 pounds.

For extremely corrosive service, the valve is manufactured in monel, stainless and other special alloys. It is fitted with renewable stainless steel valve stem, plug and seal rings.

More complete information about the valve may be obtained from the manufacturer.

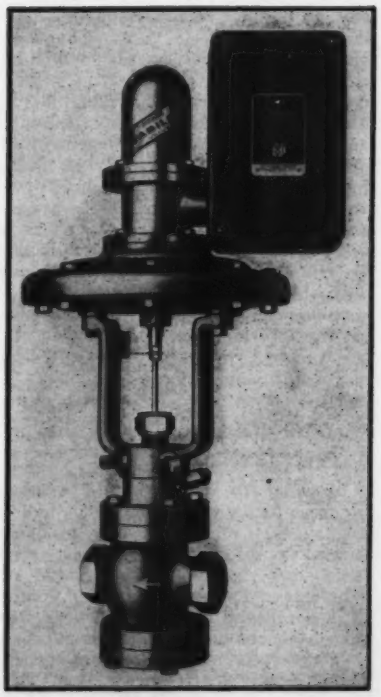
◆ Metal Supported Roof Arch For Boiler Furnaces

George P. Reintjes Company, 2517-19 Jefferson St., Kansas City, Mo., according to a recent announcement, has adapted its standard wall tiles for use as rear arches on horizontal return

tubular boilers. The design is such that each tile is hung individually by an independent casting from a pipe. Infiltration of excess air is prevented by the placing of a standard 9 inch fire brick between each pair of tiles and yet providing for freedom of expansion and contraction. The flat suspended arch is stated to increase boiler efficiency by providing turbulence in the gases so that all of the boiler tubes receive an equal proportion of the hot gases.

◆ Air-Operated Control Valve Accessory

The Vernier Valvactor, a new accessory for air-operated control valves, has been developed by The Foxboro Company, Foxboro, Mass., to eliminate valve sticking and to assure hair-line valve positioning. This device enables throttling type air-operated control instruments to make small gradual adjustments of the control valve position regardless of friction or hysteresis. It is claimed that the air from the control instrument need change as little as ½ inch in water to cause a corrective positioning of the valve and force the stem



to take a position within 1/1000th inch of the previous one.

The unit is mounted in a cast aluminum case; is completely waterproof; and may be exposed to the elements. The case is also available in gas-tight construction.

The Vernier Valvactor can be attached directly to the spring housing of all sizes of Stabilflo valves; while for needle valves and valves without the Stabilflo type of motor, it is mounted on the side of the motor supports.

◆ Oil-Resisting Pneumatic Hose

A new air hose with tube made from a compound similar to that used in oil conducting hose and which can be saturated with oil for long periods of time without affecting its durability has been developed by The Republic Rubber Company, Youngstown, Ohio. The plies of this hose are constructed from a specially twisted cord which is impregnated with a tenacious rubber compound. Construction details of the hose are stated

to be so balanced and engineered as to result in strength without excess bulk or useless weight.

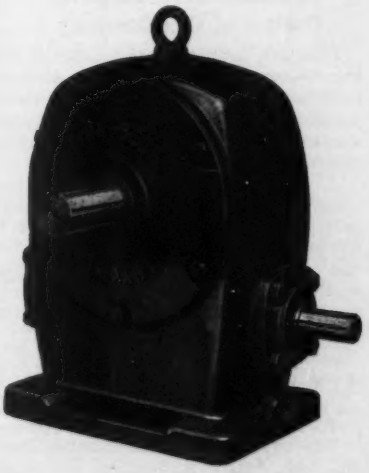
The hose is said to offer great resistance to heat, high pressures, abrasion and exposure; and is recommended for general industrial use where service is exceptionally severe.

◆ Cut-Tooth Worm Gear Speed Reducer

Announcement is made by the Link-Belt Company, Philadelphia, Pa., that it has developed a new line of cut-tooth worm gear speed reducers. The new reducers are available in a wide range of ratios and capacities, with single or double reduction, and in horizontal and vertical types.

Each unit is provided with tapered roller bearings and automatic lubrication within a dust-proof gray iron housing. The output shaft can be located above or below the worm shaft. The worm wheel on the output shaft is of chilled phosphor bronze, while the worm shaft is of a low-carbon alloy-steel forging that is carburized and heat-treated after the cutting of the worm threads thereon.

A feature of the double-reduction reducer is the unitized attachment of pri-



mary reduction unit to the side of final-reduction housing.

The name plate of each worm reducer, conforming with the recently recommended practice of the American Gear Manufacturers Association, is stamped to indicate the ratio, input and output R. P. M., input horsepower or output torque capacity, and service factor used in determining the rating for which the unit has been sold.

◆ L. D. Bennett Made President of Dilts

The Dilts Machine Works, Inc., Fulton, N. Y., announce election of officers of the company as follows: President, L. D. Bennett, who succeeds the late B. W. Bennett; vice president, J. D. Haskell; treasurer, J. D. Bennett, and secretary, W. J. Bennett.

After spending about four years with the Texas Company in China, J. D. Bennett became associated with the company prior to the passing of his father, the late B. W. Bennett.

◆ William MacGregor

The Carborundum Company, Niagara Falls, N. Y., announces the passing on December 18 of William MacGregor, general sales manager, and one of the most beloved and influential members of the company's official staff.

Mr. MacGregor was born in Kenney, Aberdeenshire, Scotland, on October 5, 1888. After his schooling, he joined the organization of his uncle, William MacGregor, in the manufacturing and manufacturing agency business at Airdrie. In 1912 he came to the United States to join the sales staff of the Carborundum Company. After spending several years traveling, he became general sales representative of the abrasive paper and cloth department and in 1918 was appointed as sales manager of the stone and marble, and the paper and cloth departments. In August, 1926, he was made general sales manager of the company.

Surviving Mr. MacGregor are his widow, a son and two daughters.

◆ Container Corp. Acquires Control of Can Company

Effective January 1, the name of Sefton National Fibre Can Co. is changed to Sefton Fibre Can Company. Container Corporation of America has acquired controlling interest in the above mentioned newly-reorganized company.

A. J. Baumgardt, for many years comptroller of the Container Corporation, will be president, and Arthur H. Grace will continue as vice-president of the can company. Both sales and operations will continue to be handled from the main office of the Sefton Fibre Can Company at St. Louis.

◆ Ontario Paper Plans Newsprint Plant

The president of the Ontario Paper Co., Ltd., Arthur A. Schmon, last month confirmed reports that the Ontario Paper Co., Ltd., intends to complete the work of building a newsprint plant in the vicinity of Manicouagan. This company has decided to proceed immediately with completion of its water-power development on the Outarde river and the construction of a modern groundwood and newsprint paper mill with a daily capacity of 320 tons, at Comeau Bay on the north shore of the Lower St. Lawrence near the Manicouagan river, opposite Rimouski. Mr. John Stadler has been engaged as consulting engineer, but the engineering work on the plans and specifications will be performed by the company's engineers at its Thorold plant.

The Ontario Paper Co. owns a large tract of pulpwood limits on the Manicouagan watershed and water powers on the Outarde river which are held by lease from the Quebec government, under which the company is obliged to develop the water power and construct a mill near the basin of the Manicouagan and Outarde rivers. The time for completing the project has been twice extended during the depression, but substantial sums have been expended on dams, hydraulic works and other improvements.

Specifications are being issued to Canadian and American manufacturers for two paper machines with a trim of 250 inches.

The Ontario Paper Co., Ltd., is an affiliate of the Chicago Tribune and the Daily News of New York. The newsprint requirements of the publishing companies are in excess of the present manufacturing facilities at Thorold, and for many years the parent companies have been purchasing newsprint from other manufacturers at market prices, for quantities in excess of 100,000 tons annually. Having regard to the present and future newsprint requirements of the two newspapers The Ontario Paper Co. has now decided to proceed at once with the construction of a mill and to complete the development of water powers in conformity with its contract with the Quebec government. The mill is to be ready for operation by May, 1938.

◆ Crane Company Establishes New Division

In order to maintain and enhance progress in its diversified fields, and to foster the invention of new products, Crane Company, Chicago, has established a Division of Research and Development. The importance and volume of research and development work warrants the constant full time effort of a group of technical specialists entirely divorced from routine production. They will devote their entire time to a study of the requirements of the trade, with freedom to pursue the research designing and experimental work necessary to improve existing products, and to develop original designs and materials for new products. The research and development work formerly handled by various departments and subsidiaries will be expanded and centralized in the new division, which will be responsible directly to the president, with the vice president of manufacture and the vice president of sales acting in a co-ordinating capacity. M. W. Link will head the new division, with the title of Director of Research and Development.

Announcement also is made of the creation of a new Product Engineering Department at the Chicago Works under the jurisdiction of the vice president of manufacture. There will be close association between the Division of Research and Development and the Product Engineering Department, so that the latter may place in proper production the products or improvements in existing products developed by the Division of Research and Development.

◆ L. E. Griffith Vice President of Riley Stoker

The Riley Stoker Corporation, Worcester, Mass., announces the appointment of L. E. Griffith as vice president and general manager of the corporation. Mr. Griffith's extensive experience and broad knowledge of the power plant industry admirably qualify him for this new position.

After graduating from Lafayette University in 1912, Mr. Griffith became construction engineer with the Thompson Starrett Company at Chicago and New York, superintendent of the General Metal Products Company of Canton, Ohio, construction engineer of the Pittsburgh Seamless Tube Company of Beaver Falls, and production engineer of the Babcock & Wilcox Company at Barberton, Ohio.

At the time of the purchase by the Riley Stoker Corporation of the United Machine & Manufacturing Company, Mr. Griffith was president and general manager of that company. With the consolidation of these two companies he became manager of the New York office of the Riley Stoker Corporation in 1924.

In 1928 he was appointed sales manager of the corporation and in 1929 was elected vice president in charge of sales and a member of the board of directors.

◆ Publications Available Through Philadelphia Quartz Co.

Among the technical publications available through the Philadelphia Quartz Company, Philadelphia, the following list may contain some that are of interest to readers of THE PAPER INDUSTRY:

"Evidence on Paper"—A résumé of the Neilson Survey reports; conclusive evidence reported by papermakers of usefulness of silicate in paper.

"Silicate of Soda in Paper Making"—Detailed description of the methods of using silicate of soda in the beater, and the results to be obtained from it. Other paper mill uses.

"Coating Paper Board"—The use of silicate of soda for making greaseproof and water-resistant paperboard.

"Adhesive Silicate of Soda for Fibre Containers"—Reprinted from *Fibre Containers*, June, 1934. A discussion of silicate adhesive including silicate-clay mixtures.

"Soluble Silicates, their Influence on Hypochlorite Bleach"—Reprinted from *Industrial and Engineering Chemistry*, March, 1926. A careful study of the effects of silicate solution in increasing the efficiency of chlorine bleach, both in conserving chlorine and in improving the color of bleached fabrics or pulp.

The above publications are listed in P's & Q's, December, 1935.

◆ New Catalogues and Publications

Chemical Publishing Company, 175 Fifth Avenue, New York—"If I Only Had That Book," is the title of the latest technical book catalogue, recently published by this company. Over 1,300 domestic and foreign technical books of all publishers are listed. This enables any technical worker to obtain on one order, from one source, any technical book. It also eliminates getting more than one invoice and having to mail out separate checks. Ask for Catalogue No. 3. It's free to technical workers.

Combustion Engineering Co., 200 Madison Ave., New York—Three pieces of new literature have just been received. One features the Coxe traveling grate stoker and describes recent improvements in this stoker and its drive. All parts are exceptionally well illustrated. A 16-page catalogue illustrates and describes details of the C-E Sectional-Header Boiler as built for a wide range of steam pressures, capacities and different methods of fuel firing. Representative installations are included, as well as shop photographs showing the fabrication of such boilers and their inspection. An 8-page bulletin describes and illustrates in detail the company's "Design MRO" multiple-retort stoker. Test data and typical operating results are included.

Glyco Products Co., 949 Broadway, New York City—The latest edition of this company's catalogue "Chemicals by Glyco," has just been published. Several new products which were on display at the recent Chemical Exposition are fully described. A welcome addition to the Chemical and Physical tables has been the inclusion of pH tables of the most common acids and bases. Copies to executives, chemists or technical workers on request.

Ideal Commutator Dresser Co., Sycamore, Ill.—An interesting new folder contains a number of application photographs from installations in different industries showing how this company's Tel-Temp industrial thermometer is used to indicate temperatures on such machines as open and closed motors, generators, busbars, pump bearings and condensate pumps. One illustration shows this instrument installed on a ceiling-mounted motor so that operating temperatures can be read from the floor. Copies upon request.

Ingersoll-Rand Co., Phillipsburg, N. J.—A new bulletin describes the I-R line of power-driven, horizontal duplex, double-acting, cross-head type, moderate speed, heavy-duty compressors. The types covered are the XRE which are direct-connected, synchronous motor-driven units; and the XRB and XCB which are belt driven. The descriptive sections are profusely illustrated with fine halftones, some in color, and there are double-page, diagrammatic illustrations graphically explaining the details of construction. Copies on request. Ask for No. 3162.

Jeffrey Manufacturing Co., Columbus, Ohio—This company's new catalogue No. 417 (400 pages) covers chains, sprockets, transmission machinery; spiral conveyor, elevator and conveyor parts, along with all other Jeffrey materials handling equipment parts. Gives specifications, list prices, and is well illustrated. The materials handling, electric vibrating equipment of the Jeffrey-Traylor type is featured in a new catalogue, No. 610 (64 pages). This booklet gives specifications of the various types; deals exclusively with typical installations covering feeding, screening, conveying, packing, cooling, drying and other handling operations.

Northern Engineering Works, 210 Chene St., Detroit, Mich.—This company's bulletin EH-250 illustrates its latest development in overhead monorail electric hoists for heavy loads, known as Northern Hi-Lift Hoists. There are illustrations and 9 important advantages are listed as being combined in this hoist.

Pacific NW Forest Experiment Station, U. S. Court House, Portland, Ore.—This station recently published Forest Research Notes No. 17, entitled "Pulpwood Resources of Western Oregon and Western Washington," by H. F. Andrews, R. W. Cowlin, F. L. Moravets and W. H. Meyer. This publication includes authoritative data concerning the extent and character of the pulpwood resources of the region and is a product of a forest survey recently completed. It contains 12 tables showing volume of pulp timber by species and ownership classes in cubic feet and cords, the areas occupied by the pulpwood types, and current and potential annual growth of pulpwood species. It also includes 5 figures which show the geographical distribution of pulpwood volume and type areas in the region and contrast depletion, growth and pulp-mill capacity. Although wide distribution of this publication has been made, copies are still available from the Station.

Pittsburgh Piping & Equipment Co., 43rd St. & A. V. R. R., Pittsburgh, Pa.—A new bulletin lists Pittsburgh Piping stainless steel pipe fittings, with prices and discounts. One page is devoted to illustrations of an actual case of "before" and "after" in the redesign of a paper mill piping layout.

Robbins & Myers, Springfield, Ohio—Bulletin 6161, just received, shows a few of the many types and capacities of electric hoists and cranes that will be manufactured by this company. The principles of manufacture are explained and specifications are given. Typical installations are illustrated; and there are also clearance diagrams and tables, and a variety of general information for anyone interested in electric hoists and cranes.

Jos. T. Ryerson & Son, Inc., Chicago—An attractive new booklet graphically presents the beauty, the popularity and the enduring radiance of stainless steel. A beautiful spread in four colors presents dozens of stainless articles. Other illustrations indicate the popularity of stainless steel and its application in all lines of industry. This unusual booklet is bound with a cover done in silver, maroon and green with green Cellophane fly sheets, and will be of interest to anyone planning the use of stainless steel in various applications. Copies will be sent if requested on your company letterhead. Address the company, Post Office Box U, Chicago.

BOOKS

Accounting Procedure for Standard Costs—The Ronald Press Company, 15 East 26th St., New York City, recently issued this book, bound in a three-ring binder with an attractive stiff cover. It is the work of Cecil Merle Gillespie, Assistant Professor of Accounting, Northwestern University. In his treatment of the subject, the author includes information on the development of standard costs, describes each of three distinct methods of operating cost systems and shows the workings of each of the several methods by presenting five detailed case studies from actual field work. The material is presented as a series of fifteen co-ordinated lectures, and includes, in addition to numerous charts and diagrams, rate cards, cost sheets, and reports of many kinds, a bibliography of reading references to books, bulletins, yearbooks, magazine articles, etc., on standard costs as applied to specific industries. Two of these literature references cover material relating to papermaking. The price of the book is $5.00 per copy.

Adressbuch der Papier-, Pappen- und Papierstoffabriken Deutschlands und seiner Nachbarstaaten. (Directory of the paper, board and pulp mills of Germany and neighboring countries.) This is the 25th edition of a directory first published in 1871 by Heinrich Günnter. Within it are listed the paper, pulp and board manufacturers of Belgium, Denmark, Alsace-Lorraine, Esthonia, Latvia, Lithuania, Luxemburg, Austria, Poland, Switzerland, Czechoslovakia, and Holland, in addition to such firms in Germany. In the case of German firms, the manufacturers are listed under the general headings of the states or provinces (e.g. Bavaria, Anhalt, Saxony) and under the subheadings of the towns or cities of the particular province in which the mills are located. While details of the information given vary depending on circumstances, the directory usually gives such data as the year of founding, present owners, present superintendent, banking connections, power consumption, products, daily production, raw materials used, etc. Certain mills manufacturing specialties like parchment, marbled and waterproof papers, etc., are listed in a separate division of the catalogue. Trade associations, technical societies, and vocational papermaking schools also are listed. An interesting section of the directory gives full illustrations of the best known watermarks used in Germany and cites the trademarks of the German paper industry. Another section classifies and lists the various paper and pulp products made in Germany, and under each product gives the names and addresses of the mills that supply it. Finally, sources of supply for various items required by the paper industry are given. As evidenced by the foreword to the volume, there are now about 800 mills in Germany, supplying paper, pulp, board, or related products. Since the appearance of the last edition of the directory, 12 board mills, 8 groundwood mills, 4 paper mills, 1 mill producing groundwood as well as paper, 2 mills manufacturing paper and board, and 3 mills manufacturing groundwood and board have closed down. This directory, which should prove invaluable to those dealing with the manufacturers of Germany or of those states which lie on her borders, is published by Günnter-Staib Verlag, in Biberach a. d. Riss. Its cost is 10 R.M.

Introducing Paper—This book, written by T. Brown and published by J. Whitaker & Sons, Ltd., 12, Warwick Lane, E. C. 4, London, England, is intended to provide the neophyte entering the paper trade with an elementary knowledge of paper—its production, grades, and uses. The presentation is entirely non-technical and includes chapters on paper manufacturing, types of paper, paper testing, paper measurement, and on the trade itself with some reference to printing. For the most part, the information describes methods common to England or the continent, but reference also is made to practices in other paper producing and consuming countries. It is a little book of 72 pages, that is bound in a paper cover and is priced at 1/6 net.

The Paper Mills Directory of Great Britain and Ireland—The 1935-36 edition, the 75th annual issue of this well-known directory, has been published. The book is divided conveniently into four parts. The first part lists the paper and board mills of both England and Wales; the paper mills of Scotland and Ireland; the coaters, enamellers, surfacers, finishers and converters of paper; corrugated paper manufacturers; manufacturers of transparent cellulose wrapping; and the paper stainers in Great Britain. Part II is given over to paper distribution and sales data including a listing of London agents of British paper mills as well as of London paper merchants and wholesale stationers. Allied and associated trade data appears in Part III. This data covers the manufacturers of equipment and engineers; merchants for china clay, pulp and esparto; chemical and color manufacturers; and the dealers in paper stock and waste paper. General trade information is presented in Part IV. This information includes data on the various trade associations, trade customs, import and export information, trade names, and watermarks. Bound in heavy paperboard cover, the book is made up of approximately 400 pages of data pertinent to the paper trade of Great Britain and Ireland. Selling for two shillings and six pence net, the book may be obtained from Printing-Craft, Ltd., 18 Featherstone Buildings, Holborn, W. C. 1, London, England.

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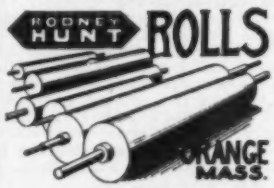

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◆ Plan Progressing for the Annual Meeting of the A. P. & P. A.

The fifty-eighth convention of the American Paper and Pulp Association will be held at the Waldorf-Astoria Hotel, New York City, February 17 to 21. During this week, which is known as "Paper Week," various organizations that are a part of the association, or affiliated with it, will hold special sessions. The dates for some of these are:

Technical Association of the Pulp and Paper Industry; convention at the Waldorf-Astoria Hotel, February 17-20. Annual luncheon at the hotel, Thursday, February 20.

Salesman's Association of the Paper Industry. Annual meeting and luncheon at Waldorf-Astoria Hotel, Tuesday, February 18.

National Paper Trade Association of the United States. Convention at the Waldorf-Astoria Hotel, February 17-21.

Tentative Program for T. A. P. P. I. Meeting

The tentative program of papers to be presented at the sessions of the Technical Association of the Pulp and Paper Industry is as follows:

Heat and Power Engineering:
- Power Requirements in the Paper Mill, by H. W. Rogers.
- Rate of Drying Writing Paper, by F. W. Adams.
- Drying Rates for Glassine and Greaseproof Paper, by V. F. Waters.
- Drying Rates for Tissue and Absorbent Papers, by A. E. Montgomery.
- Heat Recovery in the Alkaline Pulping Processes.
- Diesel Engines as Applicable to the Paper Industry, by M. J. Reed.
- Boiler Feed Water Treatment, by E. W. Butzler.
- Mechanism of Electrical Design, by C. J. Koch.

Materials of Construction:
- Cast Ferrous Alloys, by F. L. La Que.
- Non-Ferrous Alloys, by J. T. Kemp.
- Steam Pipe Insulation, by J. W. Hemphill.

Paper Coating:
- Offset Lithography on Coated Paper, by R. E. Reed.
- Using a Pebble Mill, by S. J. Dickhaut.

Sulphite Pulping:
- A Survey of Pitch Troubles in the Manufacture and Use of Sulphite Pulp, by Otto Kress and L. A. Moss.

Bleaching:
- The Mechanism of Bleaching, by F. E. Brauns.

Management:
- The Paper Industry and the Business Cycle, by L. T. Stevenson.

Stuff Preparation:
- The Thorsen-Hery Beater, by G. W. Dodge.
- Waste Paper Stock Preparation, by Edwin Cowles.
- The Refining Action of Discs, by D. M. Sutherland, Jr.

Mechanical Pulping:
- Effect of High Pit Temperature and Preheating of the Wood on the Grinding of Loblolly Pine, by J. C. Pew and R. G. Knechtze.
- Occurrence of Compression Wood in Black Spruce and Its effect on the Properties of Groundwood Pulp, by M. Y. Pillow, E. R. Schafer and J. C. Pew.

Laminating of Board:
- Combining Problem, by W. T. Marble.

Pigments:
- The Retention of Pigments in Paper, by F. A. Steele and J. H. Haslam.
- Effect of Beating and Pigmentation on Sheet Properties, by W. R. Willets.

Alkaline Pulping:
- A Method of Predicting Yields in the Soda Process, by D. W. McCready and W. J. Nolan.
- Application of the Cottrell Electrical Precipitation Processes to the Recovery of Dust in Stack Gases from Recovery Plants, by N. W. Sultzer and G. Beaver.

Forestry:
- A Comparison of the Rate of Growth of Pacific Coast Wood and Southern Pine, by David Hervey.

● *Illustration showing Impco Vacuum Washer and Thickener as supplied to West Virginia Pulp and Paper Company. Manufactured by Improved Paper Machinery Corporation, Nashua, New Hampshire. This unit equipped with Monel Metal vat and repulper lining, Monel Metal winding wire and Monel Metal wire cloth cover over vacuum drum as well as wire cloth facing on the suction roll and press roll.*

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In addition to these qualities of the metal itself, Monel Metal wire cloth facing and winding wire are available in all standard sizes, weaves and meshes. For these reasons, Monel Metal wire cloth is used in a dozen places around the modern mill:

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High Density Thickeners
Washers and Thickeners
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Cylinder Paper and Board Machines
Brown Stock Washers
Black Liquor Filters
Lime Mud Filters
Screens
Salt Filters

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Suction Box Trays
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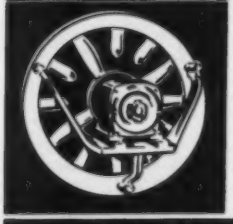

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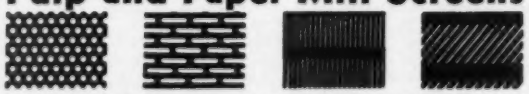

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Pulp Testing:

Further Experiments with the Kollergang Beater, by J. d'A. Clark.

Some Factors Influencing the Sampling of Pulp Shipment for Moisture, by F. W. Brainerd.

Pulp Testing, by a Rapid Sheet Making Process, by James Coghill.

A Universal Hydrogen-Ion Indicator, by D. T. Jarben and J. L. Parsons.

Paper Testing:

Water Vapor Permeability, by Allen Abrams and E. S. Worth.

Grease Resistance of Paper, by H. L. Mellen.

Chemical Testing Methods, by P. F. Wehmer.

Physical Testing Methods, by R. C. Griffin.

Some Observations on Burst, Tensile and Stretch Tests, by J. d'A. Clark.

Water Resistance of Paper by P. W. Codwise.

The Nature and Measurement of Paper Acidity, by B. L. Browning and R. W. K. Ulm.

Fundamental Research:

Preliminary Report on the Existence and Nature of Pulp Membranes, by H. F. Lewis.

Preparation and Constitution of Lignin, by W. M. Fuchs.

There will also be a number of reports by committees on projects under way and completed.

The annual luncheon of the Association will be held on Thursday, February 20, 1936. Announcement will shortly be made concerning the speaker.

◆ Chemists Unemployment Committee Gains Support

A report of its activities has been published recently by the Committee on Unemployment and Relief for Chemists and Chemical Engineers, 300 Madison Ave., New York City. This committee, also known as Chemists' Unemployment Committee, was formed in the winter of 1931 and began to function actively in the early part of 1932. It is sponsored by a number of technical societies in the Greater Metropolitan area, one of which is the Technical Association of the Pulp and Paper Industry.

The requirements for registration are: (1) a college degree in chemistry or chemical engineering; in the case of a non-graduate, four years' experience in industrial chemistry; (2) residence within a radius of fifty miles from New York City a year previous to registration. However, due to constant requests for help from unemployed chemists and chemical engineers residing outside the Greater Metropolitan area, a separate supplementary file has been maintained which includes those who do not fulfill all the above requirements, especially as regards residence, but are bona fide members of the profession.

Since the inception of the Committee to date, 2142 qualified chemists and chemical engineers have registered. Of these, 358 are on the supplementary out-of-town list representing all states of the union. A total of 574 have been reabsorbed in the chemical industry on permanent jobs.

In an effort to secure adequate information regarding the status of the unemployed, a questionnaire is mailed periodically to the registrants on the active file. Only those replying to the canvass as unemployed or unsuitably employed are kept on the active file. The successive results of these canvasses, with the usual eliminations, bring the Committee's active file as of November 1, to 485. Of these, 154 have temporary unsuitable jobs and 331 are totally unemployed.

The Committee's work is financed from funds contributed by individuals in the profession. Since 1932, six appeal letters have been mailed. Response to these calls for help has come from 1,278. Thirty-nine companies voluntarily contributed. Chemists and chemical engineers employed in 16 laboratories, representing 199 persons, have sent in combined group contributions from their respective laboratories.

It is generally thought that in continuing or perpetuating the efforts of the Committee, the profession will reap benefits not only from the standpoint of individuals, but also by improving the status of the chemist and hence the morale of the profession.

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Have you ever figured out what a slight extra reduction of the moisture content of a sheet of paper on the wet end means in reduced steam costs on the dryer end?

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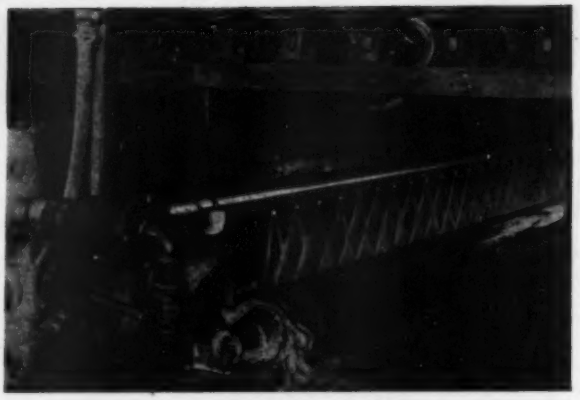

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The pioneer and most successful white water shower. Also made for fresh water. Try one.

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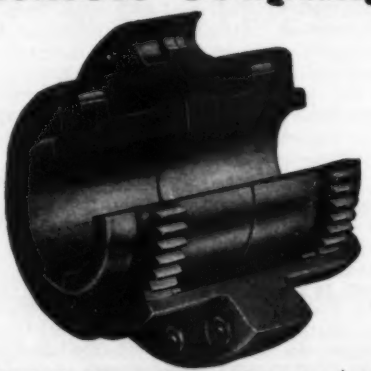

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The Paper Industry Safety Contest

July 1, 1935 to June 30, 1936

Cumulative Scores as of November 30

29 Perfect Scores

PERFECT SCORES

Division I—Paper and Pulp Mills

	PARTICIPANT	MILL	LOCATION
GROUP A	Hollingsworth & Whitney Co.	Algonquin & Tsconnet	Waterville, Me.
GROUP B	Kimberly-Clark Corp.	Badger-Globe	Neenah, Wis.
	St. Croix Paper Co.	Woodland	Maine
	Container Corp. of America	Cincinnati	Ohio
GROUP C	Continental Paper & Bag Corp.	York Haven	Pennsylvania
	International Paper Co.	Little Island	No. Tonawanda, N. Y.
	Finch, Pruyn & Co., Inc.	Glens Falls	New York
	Crystal Tissue Co.	Middletown	Ohio
	Hoberg Paper & Fibre Co.	Fibre Div.	Green Bay, Wis.
	Ontonagon Paper Corp.	Ontonagon	Michigan
GROUP D	Harriman Company	Harriman	Tennessee
	International Paper Co.	Webster	Orono, Maine
	Hollingsworth & Whitney Co.	Arcostook & Cobbossee	Gardiner, Me.
	Bird & Son, Inc.	Phillipsdale	Rhode Island
	Central Fibre Prods. Co.	Vincennes	Indiana
	Spaulding Fibre Co., Inc.	Milton	New Hampshire
	U. S. Gypsum Co.	Gypsum	Ohio
	U. S. Gypsum Co.	No. Kansas City	Missouri
	Central Fibre Prods. Co.	Mt. Carmel	Illinois
	Hollingsworth & Whitney Co.	Abenaquis	Madison, Me.
	International Paper Co.	Riley	Maine
	Mead Paperboard Co.	Roxport	Indiana

Division II—Remanufacturing

Union Bag & Paper Corp.	Specialty	Hudson Falls, N. Y.
Kimberly-Clark Corp.	Atlas	Appleton, Wis.
Continental Paper & Bag Corp.	Elisabeth	New Jersey
Container Corp. of America	Natick	Massachusetts
Texas Corrugated Box Co.	Dallas	Texas
U. S. Gypsum Co.	Genoa	Ohio
Bemis Bros. Bag Co.	East Pepperell	Massachusetts

IMPERFECT SCORES

	Key Number	Rank	Disabling Injuries	Frequency Rate
GROUP A	P- 30	2	1	1.356
	P- 44	3	3	4.337
	P-101	4	3	4.486
	P- 78	5	4	5.630
	P- 67	6	6	6.166
	P- 64	7	4	6.799
	P- 27	8	10	7.001
	P- 31	9	4	7.735
	P- 10	10	5	7.749
	P- 1	11	8	7.951
	P- 12	12	5	8.358
	P- 19	13	6	9.191
	P- 18	14	9	10.874
	P- 2	15	7	11.781
	P- 62	16	10	11.927
	P- 13	17	9	12.099
	P- 23	18	6	13.903
	P- 60	19	10	14.117
	P-102	20	15	17.593
	P- 95	21	11	18.577
	P-114	22	14	24.464
	P- 73	23	24	30.043
	P- 87	24	20	30.590
	P- 74	25	31	38.608
	P- 71	26	31	54.711
GROUP B	P- 68	4	2	4.888
	P- 11	5	2	5.279
	P- 21	6	3	6.488
	P- 22	7	3	7.377
	P- 26	8	4	8.803
	P- 54	9	3	8.966
	P- 60	10	4	10.933
	P- 82	11	5	11.280
	P- 51	12	4	11.453
	P- 3	13	5	14.192
	P-112	14	5	14.633
	P- 25	15	9	18.049
	P- 16	16	7	18.652
	P- 40	17	11	22.303
	P-104	18	8	26.036
	P- 76	19	12	34.327
	P- 45	20	14	35.578
	P- 32	21	18	37.929
	P- 77	22	19	54.331
GROUP C	P- 97	7	1	6.342
	P- 59	8	2	7.227
	P- 55	9	2	8.521
	P- 72	10	3	10.246
	P- 43	11	2	10.485
	P-103	12	2	12.783
	P- 6	13	2	13.034
	P- 37	14	4	16.005
	P- 47	15	4	20.207
	P- 88	16	5	20.292
	P- 4	17	6	20.447
	P- 41	18	4	20.798
	P- 29	19	5	21.584
	P- 48	20	6	26.450
	P-111	21	6	28.805
	P- 49	22	5	29.100
	P- 75	23	7	30.020
	P- 24	24	6	32.840
	P- 89	25	8	39.873
	P- 33	26	10	45.089
	P- 14	27	8	45.864
	P-107	28	8	49.387
	P-113	29	20	78.959
	P- 50	30	15	91.099
GROUP D	P- 81	13	1	7.560
	P- 7	14	1	7.585
	P- 53	15	1	11.980
	P- 65	16	1	16.550
	P-118	17	2	19.732
	P-116	18	3	22.189
	P- 35	19	2	23.446
	P- 90	20	2	25.122
	P-117	21	3	25.961
	P- 94	22	3	27.354
	P- 80	23	4	27.719
	P- 8	24	2	28.656
	P- 85	25	1	30.816
	P- 42	26	3	37.137
	P- 98	27	5	40.431
	P- 34	28	5	52.836
	P-106	29	7	57.417
	P- 99	30	4	57.563

Division II

	R-20	8	1	2.483
	R- 1	9	1	5.555
	R-18	10	1	6.582
	R- 3	11	1	9.213
	R- 6	12	5	9.775
	R- 5	13	5	10.643
	R- 9	14	1	10.688
	R- 2	15	5	13.638
	R-21	16	6	15.214
	R-14	17	1	16.532
	R-10	18	10	36.844

No November report: U. S. Gypsum Co., No. Kansas City, P-23, P-114.

No October or November report: Continental Paper & Bag Corp., Elisabeth, N. J.

Withdrawn: P-79, P-83, R-17.

WHAT'S NEEDED HERE? ✳

▼ *A lead pipe?*

▼ *A dose of castor oil?*

▼ *Or a pair of good glasses?*

Last month we asked for bids on our 1936 calendar. It is a four-color job, nothing tricky about it, just a routine matter of plate making and printing. In fact, it was more than commonly simple to figure because we furnished the paper, art work, and composition.

Here were the bids:

Printer A $1970.00

Printer B 1098.00

Printer C 650.00

Draw whatever conclusions you wish. Ours is that what the business world needs is less wishing and more knowledge; less codes and more common sense.

Uncle Jake

✳ *A souvenir will be sent to every one who sends a good answer.*

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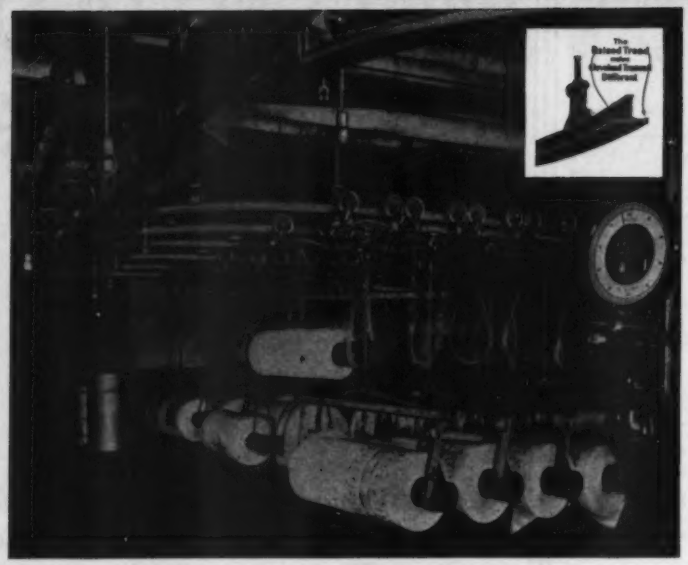

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1864 *The Qualifications of* 1936

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POWER

GENERATION + UTILIZATION + MAINTENANCE

This section turns the searchlight on power and its allied problems, showing big possibilities to save. Opportunities to improve conditions, methods, apparatus will be discovered. Worth while practices suggest new ideas and wider usages of equipment.

By W. S. JOULE

◆ Water and Steam Piping for Air Compressors

Cooling water for air compressor cylinder jackets, cylinder heads and intercoolers must always be turned on before the compressor is started. Sufficient water must be used to keep down the heat of compression. In case of stage compression the greatest efficiency is obtained by having the outlet water from the inter-cooler at a low temperature. The water supply to air cylinders and inter-cooler should be independent of each other and the flow controlled by a valve on the inlet.

Avoid using dirty water, as it clogs the water jacket and reduces the cooling efficiency. Do not forget to shut off the water when the compressor is stopped and also open all packet drains in freezing weather. Outlet water should flow into open funnels allowing frequent temperature readings; a rise in temperature indicating deficient cooling, carbonized discharge valves, or leaking piston rings.

Steam piping to air compressors should drain toward the compressor, for it is likely to contain low spots or pockets where water can accumulate, which would be carried into the steam cylinder and cause serious damage upon a sudden increase in air demand calling for a rapid flow of steam through the pipe. The use of a steam separator and trap is recommended if the compressor is located some distance from the boiler. Its use increases the safety and economy as a result of supplying drier steam.

Exhaust piping should be laid beneath the floor to the side of engine room, then vertically to the atmosphere. The pipe leading to the riser should pitch slightly toward it. The connection with the riser should be made to provide a drain for condensation. On compound steam cylinders the receiver must be drained. The drain should always be opened before the starting and steam turned into the receiver through a by-pass valve. The receiver as well as the steam cylinders should be thoroughly warmed by steam before starting. If a condenser is used, the main exhaust pipe will be connected to it but there should also be an opening to the atmosphere provided with an automatic relief valve. A stop valve should be placed in the exhaust pipe between the condenser and relief valve. Exhaust piping should drain toward the condenser.

◆ Keep the Plant Clean

Many volumes have been written on how to make a favorable first impression, as a salesman, as a job hunter, as a politician, as a business man, as a professional man endeavoring to build up a clientele. In every walk of life the first impression made upon future associates will make further progress either easy or difficult. It is only after one has acquired an intimate acquaintance with a man that you have anything more than appearances by which to judge his character. Notwithstanding this, the expert will not frequently go far wrong in his first impressions, for certain defects of character are almost invariably impressed in the mannerisms and speech of the individual.

As the workshop of engineers, the power plant makes an impression upon those who visit it, either favorable or unfavorable to the employes and owners. Nobody would look upon a purely show case plant with favor any more than he would admire the character of the scrupulously dressed dude, nevertheless the power plant that is kept clean and neat as a pin will impress the visitor with the idea that other details of the work about the plant are looked after with equal care.

Too many engineers are of the opinion that it does not pay to make a show. If that were the entire object, the cost would be too great. The fact is, however, that a poorly operated plant is extremely difficult to keep clean. Coal strewn on the boiler room floor and tracked over the entire plant, leaky boiler setting and breechings that emit soot to settle on all interior surfaces, leaky joints in steam and water piping, oil dripping from bearings or thrown from shafting are among the elements which cause a plant to become dingy and repulsive with dirt; at the same time they lower the economy of the plant to a marked degree. Thus, by bringing the economy of the plant to the top notch, the work of keeping things clean is greatly reduced. Remove the cause and the effect is eliminated.

Not only is a dirty plant caused by inefficient operation, but the effect of such an environment upon those who live in it is detrimental to economy; they are likely to give little attention to the many small details which go to make up economy.

The general character of the employes is undoubtedly reflected in the appearance of the plant. Cleanliness may be considered a nonessential element in the production of power, but a clean plant inefficiently operated is rare.

◆ Foaming and Priming

Water is sometimes carried with the steam up through the water to the surface and may fill the entire steam space. In this case the discharge from the boiler is largely made up of small steam bubbles which become separated into steam and water in the steam pipes. This is called priming, and is caused by contracted water space, insufficient steam liberating surface, poor design or overcrowding boiler.

Attendants may carelessly let the water level rise to such a high point that the steaming space and in some cases the steam liberating surface will be unduly contracted. A boiler may supply dry steam when not overworked, and yet may prime heavily when it is hard pressed.

Foaming is due to suspended impurities which form a scum on the surface of the water which foams as the steam is formed. Since foaming is caused by the condition of the water it may take place in any boiler.

Priming results in wetter steam than does foaming.

If either foaming or priming is especially violent the draft should be shut off at once and the fires covered until the cause is removed.

Surface blowing and blowing down are the most effective cures for foaming. Foaming may become so troublesome that change in the water treatment even to the extent of installing new equipment may be necessary. Oil and suspended matter must be kept out and careful filtering alone may be effective.

Both foaming and priming may be reduced by cutting down the steaming rate. Permanent improvement may often be made by the installation of dry pans or dry pipes or baffles in the steaming space which act in the nature of separators. The changing of the steam connection from one nozzle on the boiler to another has been known to improve this condition.

In some cases when the required amount of steam is fixed, especially when priming is troublesome, the most effective and really the only solution is to work more boiler capacity and thus reduce the rate of steaming.

◆ A STORY IS TOLD of Michael Faraday, who when he had demonstrated the principle of electro-magnetic induction by moving a wire before an electro-magnet was asked of what use he expected the phenomenon to be. "Of what use?" repeated the great scientist thoughtfully. "Of what use is a new born baby?"

FIG. 150
BRONZE COMPOSITION DISC VALVE

Powell Bronze, Iron And Steel Valves For Every Service

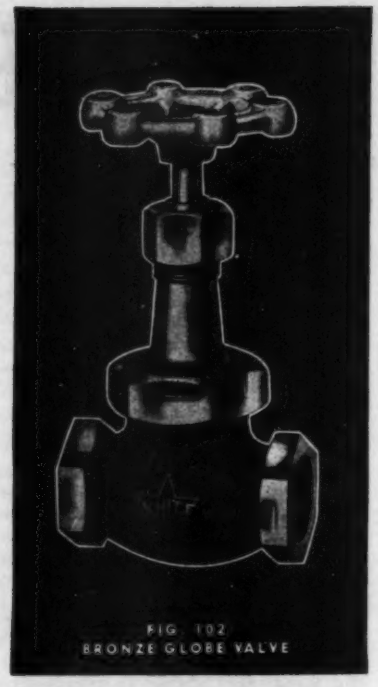
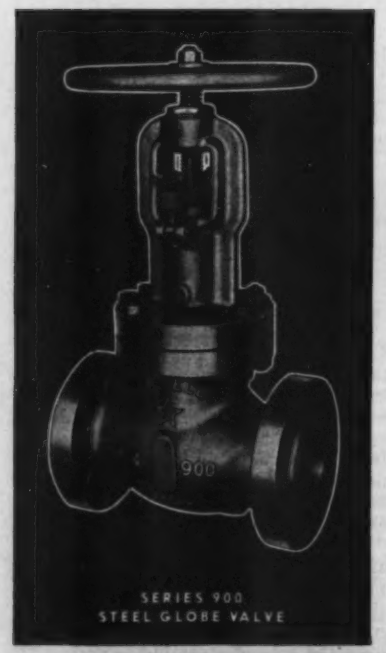


FIG. 102
BRONZE GLOBE VALVE

Powell Valves — redesigned and modernized for present day trends, mounting pressures and temperatures — are available in alloy bronzes, high test cast iron, carbon or alloy steels, and other improved materials... A complete line of Powell gate, globe, angle, check, safety, and Y valves for various pressures and temperatures offers a solution for your valve needs.



SERIES 900
STEEL GLOBE VALVE

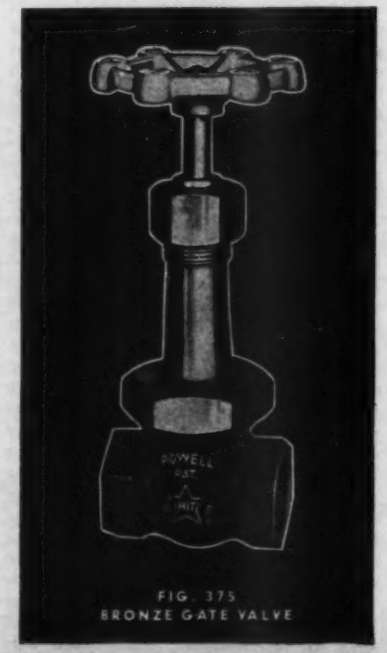


FIG. 375
BRONZE GATE VALVE

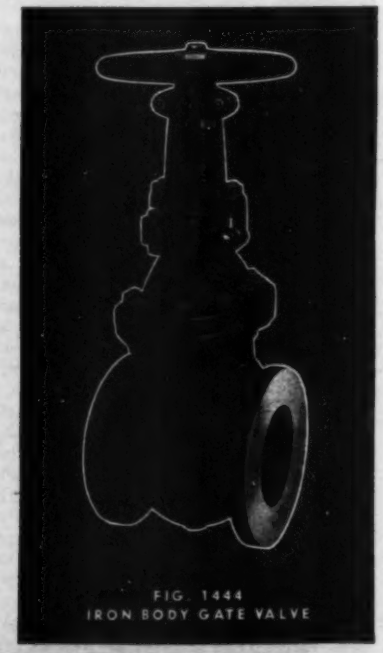


FIG. 1444
IRON BODY GATE VALVE

POWELL VALVES

THE WM. POWELL CO. CINCINNATI, OHIO

TECHNICAL DEVELOPMENTS

The following abstracts are of the latest developments found in the foreign press.

IN THE PAPER INDUSTRY

◆ Water Treatment in Papermaking

Uniform standardization of the water supplied to paper mills (rather than radical changes in the fundamentals of water purification) is probably the outstanding recent achievement of water-treatment chemists and engineers. Iron and aluminum salts used together with lime remain the best coagulants, but, where very large volumes of water must be treated, dry feeders for chemicals, similar to the one shown in Fig. 1, are supplanting solution feeders. Such dry feeders because of their reliability and efficiency may be useful in mill practice other than in water purification. While water supplies originally unsuited for mill use normally require a filter, which is often considered the heart of the purification system, auxiliary equipment is often essential to insure more than temporary relief. The authors point out the fact that in England most of the water supplies have deteriorated during the past months. Water treatment plants have been overloaded, due largely to greater pollution of the water, and to insufficient cleansing. In cases where the raw water supply is very heavily contaminated with microorganisms, these may

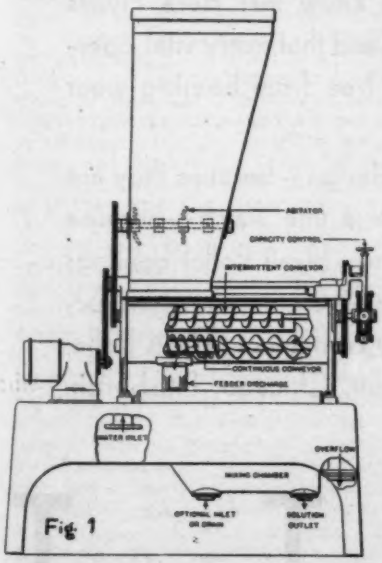
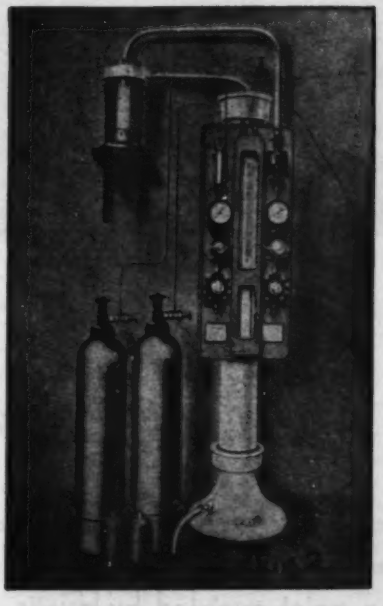


Fig. 1

cause the clogging of screens, save-alls, felts, wires, etc., and even the filters. They may give rise to slime spots and pin holes and lead to breaking of the paper, or they may give rise to deterioration of the stock. In such instances, chlorination is indicated. Algae present in raw water, and bacteria found in old paper, rags or board, as well as in water supplies, may be controlled by the use of chlorine. Slime prevention and control is a problem that requires individual study in each mill. Often it is inadvisable to attempt to chlorinate the water supply at the outset with a view towards leaving a sufficient chlo-



rine residue to affect the water of the entire system. For example, it may be best to chlorinate water in the head box in certain instances. In other cases the backwater should be chlorinated. The paper mills have raised a number of questions, voicing their suspicions regarding the use of chlorine. Among these is that of the corrosion of pumps and pipes in the mill. According to the authors, the manometer chlornome, illustrated in Fig. 2, obviates this danger. Here the residual free chlorine can be kept at any level, and even when these residues reached 0.5 to 0.8 parts per million, no corrosion was observed over long time periods. Colored papers may be produced without difficulty, by using just enough chlorine to prevent slime formation without affecting the color, or by using ammonia in conjunction with the chlorine. Only when growths are very heavy, is it necessary to flush out with strongly chlorinated water. A case of this sort occurred in a mill in Kent which, but for the installation of chlorinating equipment, and an unusually heavy chlorination at the outset, would probably have suffered a shutdown. Generally, however, it is best to clear the system gradually, thus causing the least interference with normal plant operation. The benefits of chlorination in the treatment of condenser circulating water was well illustrated in the case of a power plant in London. Prior to the installation of the chlorinating equipment, the weekly cleaning costs were approximately $150.00 (30 pounds sterling). Weekly chlorinating costs were only $55.00, a saving of $95.00. Besides this, however, there was an improvement in the vacuum of 1.5 inches, representing a saving of 1.6 per cent on the cost per unit generated. This meant a saving in fuel of roughly $9,000.00 per annum. The cost of the entire chlorinating system did not exceed $2,000.00. The adjustment of pH of the water supply is also discussed. Generally this should be below 7.0, and adjusted so that only minimum amounts of soda or alum need be added at the various points of the papermaking operation. Where chemical treatment of mill water is required, especially in the addition of chemicals under pressure, the venturi-controlled proportioning device, as shown in Fig. 3, is advantageous. The venturi tube is inserted in the pipes before they reach the pressure filters, thus controlling the formation and the addition of a saturated solution of the reagent. Through the differential head between inlet and the

Fig. 3

throat of the venturi tube, a proportional amount of water may be by-passed from the inlet through a pressure container, and returned to the main flow of water at the outlet of the tube. The container holds the reagent, and the by-passed water becomes saturated, with the rate of dosing noted by a suitable

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flow indicator. The uses and construction of such venturi-controlled devices are discussed in some detail. When $CaCO_3$ or other insoluble reagents are used, the suspension is injected by means of pumps, and agitators are required in the reagent storage tanks. Injection and measurement of a solution or suspension is effected by using a chemical ram-type pump, operated by a water turbine, the speed of which varies in proportion to the rate of the water flow, thus insuring a proportional rate of injection of the reagent. Filters are adequately discussed. The chief difficulties in their use are: (1) difficulty in maintaining a clean sand bed; (2) choking of the under-drain system; (3) high resistance offered by the filtering medium; (4) loss of sand. Of the three systems for the cleansing of filters, the application of an air-scour followed by an upward flow of water seems most effective. The other methods involve (1) mechanical stirrers and an upward flush of water and (2) the application of a high velocity wash. The efficiency of the air-scour method is dependent on the design of the under-drain system of the filter, and the careful grading of the media used in filtration, both of which are fully described. A recent development is controlled chemical proportioning apparatus, with the entire measuring and storage equipment at the ground level. Two types have been designed. One, which operates at a constant rate of flow, or not at all; and the other which operates at a varying rate of flow. In the former case, the chemicals are measured and injected by pumps having an adjustable stroke, in which the electric motor driving the pump is controlled by the flow of water to the plant. The design of the variable flow apparatus in principle resembles that of the by-pass proportioning equipment previously described. (Cf. Fig. 3.) The technique of mixing chemicals with water is discussed. The time of reaction between chemicals and the water to be softened must be carefully determined and controlled. Design of the reaction tank is of major importance, as is the velocity of water flowing to the tank. In general, if this exceeds 8 feet per hour, the authors claim that efficient settling of suspended matter is prevented and the work of the filters becomes too great. With water high in magnesia, a rate of flow not exceeding 6 feet per hour is recommended. Two important phases of water treatment have been deliberately omitted from this article, namely, that dealing with treatment of water for steam production (Cf. THE PAPER INDUSTRY, Dec., 1934, p. 649), and that of treatment of waste waters from paper mills, which is reserved for a later paper. A. H. Waddington and R. Clarke. The Paper-Maker and Brit. Paper Trade J., 90, No. 2 (T. S.) 125-128; No. 3 (T. S.) 134-5 (1935).

◆ New Control Method in Sulphite Cooks

After a thorough review of the literature, to which about 80 references are given, and a futile attempt to follow the course of the sulphite digestion by the direct use of refractrometric and specific gravity readings on the liquor as drawn from the digester at various stages of the cook, the author devised a suitable control method. This permits the rapid determination of calcium lignosulphonate by separating it quantitatively from the SO_2 and the sugars of the sulphite liquor. In brief the method is as follows:—the sulphite liquor, drawn from the digester at any stage of the digestion, is carefully freed from SO_2 by gradual treatment with $CaCO_3$. When an excess has been added, the mixture is heated to 80-100 deg. C., and shaken until no more CO_2 is given off. Subsequently the suspension is centrifuged or filtered, and the clear liquor thus obtained is cooled to 20 deg. C. In the determination, 2 cc. of this clarified so-

Fig. 1

lution are carefully pipetted into a tube and treated with 8 cc. of 95 per cent alcohol, which are added very cautiously in 0.5 cc. portions, under constant stirring. When the flocculation of the calcium lignosulphonate appears to be complete, the suspension is centrifuged for 5 minutes at 1,000 r.p.m. The clear alcoholic solution is then decanted-sharply from the moist residue, which is stirred into a paste with another portion (amount not specified) of 95 per cent alcohol and centrifuged. Thereupon the decantation is repeated. At times, in order to insure a clean-cut precipitation of the lignosulphonate (and this is especially true when the sugar content of the liquor is very low), it is best to add 0.01-0.02 g. kieselguhr, before centrifuging. The sugars are in the alcoholic mother liquors, while the solid residue contains Ca lignosulphonate. It is expedient to carry out the precipitation and centrifuging operations in a resistant glass tube (1) having a volume of 11 cc. as shown in Figure 1. Here (2) is a capillary tube, (3) is a flexible rubber tube, serving to seal the two hole rubber stopper (4) with (1), and (5) is a short glass tube leading to the suction line. Thus the residue of Ca lignosulphonate is freed from alcohol, by warming and by applying suction, and finally by raising the temperature to 100-5 deg. C. The dry powder is then dissolved in 4 cc. of water, carefully measured from a burette, at 20 deg. C. The refractive index of this solution is then taken by means of an immersion refractometer, each division of which has been calibrated to correspond to a definite weight of calcium lignosulphonate in grams per liter. This relationship is shown clearly in a table based on data obtained with the purified salt. (For this the interested reader is referred to the original paper.) A solubility factor and volume change must also be applied. Then, using the formula: $M = 0.0033 + 4B/1000 - 0.6233B$, the author calculates (M), the weight of calcium lignosulphonate in 2 cc. of the original sample of liquor, when (B) is the number of grams of calcium lignosulphonate per liter of solution (as found in the table referred to above). A series of experiments with solutions of known lignosulphonate and sugar content indicates that the experimental error, except in the case of very dilute solutions, varies from +2.3 to —4 per cent. By determining initially the index of refraction of the SO_2 free liquor, and then determining the lignosulphonate content, as indicated above, it is possible to estimate by the use of suitable tables (given by the author) the sugar content of the sulphite liquor at any step in the digestion. This indirect method was compared with Glassmann's mercuric cyanide reduction method for sugars in spent liquor (Cf. Ber. 39,503 1906), and the two methods checked within ±5 per cent. The author then followed the course of 7 sulphite cooks, each of which yielded a pulp with a different Sieber number. The new control method was used, and the results are expressed

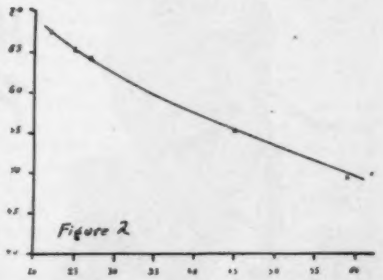
Figure 2.

graphically and in tabular form. There is a correlation between the Sieber number (for details see Schwalbe-Sieber, Die chemische Betriebs-Kontrolle in der Zellstoff-und Papier-Industrie, p. 303), the lignin content of the pulp and the amount of Ca lignosulphonate determined in the spent liquor by the new method. When for a certain form of digester and under definite cooking conditions, the Ca lignosulphonate content has once been plotted against the Sieber numbers over a wide range, it is always possible thereafter to estimate the Sieber number of the pulp at any desired stage of the cook, from the refractometric determination of the lignosulphonate. This is shown in a typical graph in Figure 2, where the ordinates are the g. lignosulphonate per 100 cc. of liquor and the Sieber numbers are the abscissas. Cölestin Haider. Papier-Fabr. 33 (Tech. Teil) 321-6, 332-5, 341-4, 347-51 (1935).

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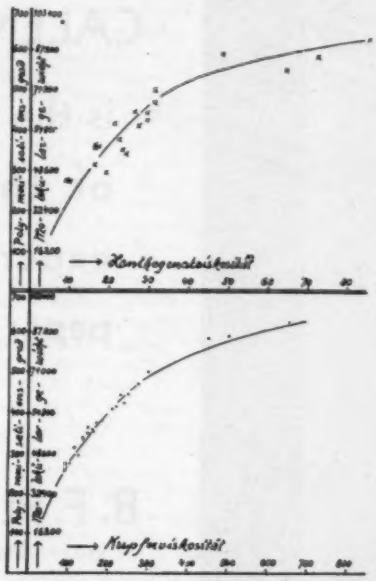
◆ Use of Nephelines in Papermaking

Due to the scarcity of papermakers alum in the U. S. S. R., substitutes have been and still are being sought. The formation of solutions of aluminum sulphate from nephelines (minerals which are themselves by-product of the apatite deposits in Russia) is briefly described. The nepheline is stirred for one hour with cold, 2Normal sulphuric acid. The clarified solution then corresponds to 17 per cent Al_2O_3. This was used in the sizing of note-book writing paper. The paper was made from a 50-50 mixture of unbleached chemical and mechanical pulp. (The method of producing the chemical pulp is not given.) The beating was carried out to 35-40 deg. S. R., and 2.1 per cent rosin and alum corresponding to 3 per cent Al_2O_3 were used. The ash content of the finished sheet was 6-7 per cent. The quality of this paper was the same as that obtained in a control experiment in which pure aluminum sulphate was used. This indicates that the nephelines may be used in place of the alum. Methods of production and the supply of raw materials are discussed briefly in the original article. Grabowskii and Muretow. Arbeiten des allrussischen Institutes für die Papier- u. Zellstoffindustrie, No. 3, 3 (1934); through Papierfabr. 33 (Abstracts) 169 (1935).

◆ Degree of Polymerization in Characterizing Pulps

Staudinger emphasized the idea that cellulose was not one substance of definite molecular weight. In other words, there are innumerable celluloses built up of the same unit cells, but having varying lengths or varying degrees of polymerization. The latter are determined on the basis of specific viscosity, the hypothesis being that sols (like the cuprammonium solution of cellulose) of equal concentration will show identical viscosities, provided they contain molecules of equal length. The viscosity thus becomes a function of the thread-like molecule (i.e., of its molecular weight). If the approximate weight of a cellulose is known, it is necessary simply to divide this figure by 162 (which is the molecular weight corresponding to $C_6H_{10}O_5$) in order to obtain its degree of polymerization. The present author has examined the literature on the viscosities of pulps measured in cuprammonium solution and also those of the corresponding xanthogenates (i.e., the sols used in viscose formation). He found that the degree of polymerization was highest in the case of certain spruce pulps (590 to 625), although in others it was much lower (295 to 365). Aspen pulps showed the lowest degrees of polymerization (275), and the pulp from cotton linters varied considerably, dropping as low as 350 and rising as high as 445. Surprisingly enough, the only pulp from cotton wadding recorded by the author had a degree of polymerization of 500 which is much lower than that of some of the spruce pulps. Another interesting fact is that on beating an individual pulp (in a Jokro mill) from zero minutes to 2 hours (i.e., from 14 deg. S.R. to 94 deg. S.R.) does not alter the molecular weight appreciably. For example, an unbeaten pulp which showed a tearing length of 1,890 and a degree of polymerization of 400, when beaten for two hours showed a tearing length of 8,640 and a degree of polymerization of 380. In fact, the difference is undoubtedly within the range of experimental error since, after beating this pulp for 30 minutes, the degree of polymerization was 410 (i.e., actually higher than that of the unbeaten material). The relationship between xanthogenate viscosity (termed (Xanthogenatviskosität) and the degree of polymerization (Polymerisationsgrad) and the molecular weight (Molekulargewicht) are clearly shown in the uppermost graph of the figure. In the lower graph is shown the relationship between cuprammonium viscosity (Kupferviskosität) and the degree of polymerization and molecular weights of various pulp samples. The curves which are very similar indicate that from a practical standpoint, the viscosity determinations are ample, and that nothing is gained by determining the degree of polymerization of a pulp sample. In this connection it is well to keep in mind that the pulps are far from being pure cellulose and that the non-cellulosic components have their effect on viscosity measurements. Experimental data indicate that there is no clean-cut relationship between copper number or alpha cellulose content of a pulp and its degree of polymerization. August Noll. Papierfabr. 33 (Tech. Teil) 377-80 (1935).



◆ Testing of Cable Papers

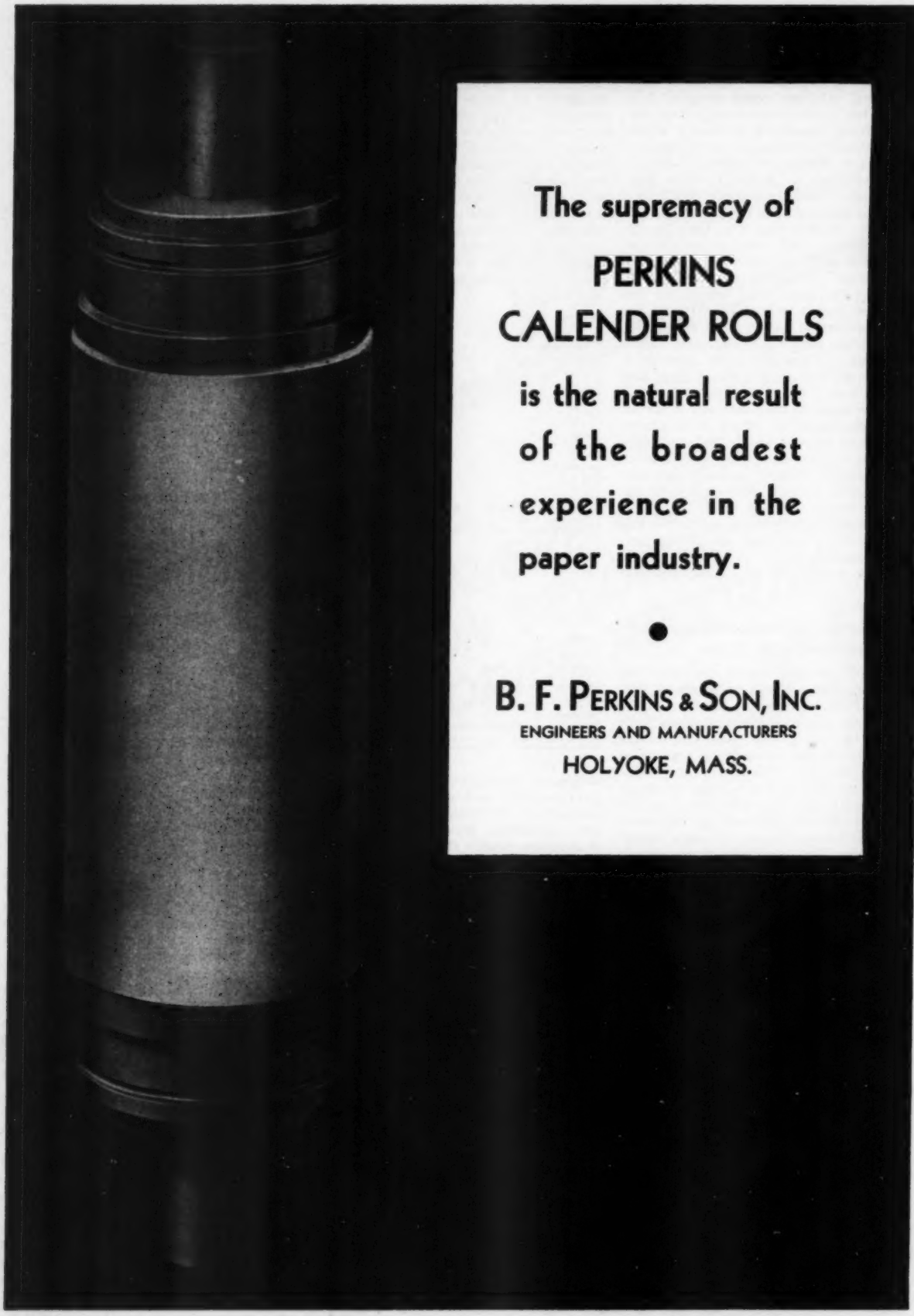
Using the Schopper torsion tester, an illustration of which is shown in the original article, the Materials Testing Laboratory at Berlin-Dahlem showed that the number of twists (in cable papers) under a definite load, up to the point of rupture, will decrease with increasing paper thickness. However, the differences shown by papers ranging from 32 to 92 grams per square meter are not very marked. A much better differentiation of such cable papers is arrived at by determining their load of rupture. R. Korn and C. Boerner, Papier-Fabr. 33, No. 1 (T. S.), 2-5 (1935); Zellstoff u Papier 15, 52-4 (1935).

◆ Sugar Formation and Degradation in Sulphite Digestions

This is the 31st article of this series on the chemistry of the sulphite digestion. The yields of sugars found in spent liquors (in cooks which yield pulp that has reached the same degree of delignification in all cases) depend not only on the acidity and lime content, but on the conditions under which the temperature changes occur during the cooking process. In general, in cooking to reach the same pulp yield, the shorter digestion will give the higher sugar yield (increases of as much as 10 per cent). The yields found experimentally correspond closely with those calculated by the authors. E. Hägglund and H. Nihlen. Pappers Trävarutid. Finland, 17,294 (Special number) 1935; through Papierfabr. 33 (Abstracts) 193, (1935).

◆ The Sulphite Cook as Effected by Liquor Composition

As the lime content of the cooking liquor increases, higher pulp yields are obtained and the resultant pulp is separated into its fibers more readily. The spent liquor is lighter in color, and its sugar content is lower. Pulps obtained with high base liquors, provided the cook is carried out under suitable conditions, are also whiter, less readily affected by light, and softer than pulps produced with acid having a lower lime content. However, if the same temperature curve is followed, and the same degree of bleachability is reached, the sulphite cook takes longer in the case of high base liquors than with those lower in lime. Doubling the lime content in a liquor means a 50 per cent increase of sulphur in the cooking acid, even though the free sulphur remains unchanged. However, if the same degree of pulping is to be reached within the same time period, it is further necessary to increase the free sulphur by at least 0.5 per cent. This means an increase of about 64 per cent sulphur, and a greater sulphur (and limestone) consumption per ton of pulp. The excess sulphur cannot be fully recovered in the relief gases. The author has calculated that, from the standpoint of costs, the increase in pulp yields is approximately counterbalanced by the increased requirements in chemicals used in the cook. J. W. Bergman. Svensk Pappers-Tidn. 38, 215 (1935); through Papierfabr. 33 (Abstracts) 193 (1935).



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Compiled by James Atkins, Registered Patent Attorney

2,018,244—Paper Product and Method of Making. Alexander V. Aim, Marblehead, Mass., assignor to Dennison Manufacturing Company, Framingham, Mass., a corporation of Massachusetts. Application October 7, 1931, Serial No. 567,419. 4 Claims. (Cl. 92—3). The method of preparing a thin, soft flexible porous sheet of paper, which comprises quickly parchmentizing only the surfaces of the fibers of a sheet of tissue paper of open formation to bind the fibers together with a water resistant bond without substantially filling the interstices of the paper.

2,018,280—Means for Impregnating Paper with Liquid. Max Oberdorfer, St. Helens, Oreg. Application June 11, 1934. Serial No. 730,117. 1 Claim. (Cl. 91—18).

Means for uniformly impregnating a web with a liquid comprising a stack of rolls, a housing inclosing one side of the peripheral face of one of said rolls, means for generating a fog of liquid within said housing, said means comprising a trough for the liquid, a driven roll rotating in said trough, and a brush cylinder rotated at high velocity adjacent to and parallel with, but not touching, said driven roll, whereby to generate a continuous current of air of high velocity over the coating of liquid carried by said driven roll, and thus generate a fog of the liquid within said housing and cause the exposed surface of said roll to receive a continuous deposit of the liquid from said fog.

2,018,382—Art of Ply Paper or Board Manufacture. John W. Sale, Hopewell, Va., assignor to Hummel-Ross Fibre Corporation, Hopewell, Va., a corporation of Virginia. Application October 24, 1934. Serial No. 749,839. 8 Claims. (Cl. 92—44). In the art of making ply paper or ply board or products of a similar nature on a traveling endless wire, continuously laying down a base sheet on the wire and continuously moving the same with the wire, partially dehydrating said base sheet as it travels, continuously delivering on the top side of said base sheet a highly diluted stream of paper stock at a point where the base sheet has become partially dehydrated, then applying suction to the underside of the wire adjacent the point where the diluted top stream of stock is delivered to the base sheet, to first mix together adjacent portions of the stock of the top stream and the stock of the base sheet and then quickly dehydrate the composite sheet and draw down the fibers of the under part of the top stream into interlocking mixed relation with the fibers of the upper portion of the base sheet to thus form a single homogeneous sheet, then further dehydrating the composite bonded sheet thus formed, and finally finishing the composite sheet in a suitable manner.

2,018,490—Method of Producing Paper Pulp from Fibrous Material. Edwin P. Jones, Garden City, and James M. Dempsey, New York, N. Y., assignors to Champagne Paper Corporation, New York, N. Y., a corporation of New York. Application April 10, 1935. Serial No. 15,620. 8 Claims. (Cl. 92—11). The improved method of producing paper pulp from flax, which consists in submitting mechanically decorticated flax to the action of water, washing the same, cooking the fibers in a digester in the presence of an alkaline chemical in combination with a soluble sulphite and then bleaching the fibers.

2,018,638—Manufacture of Transparent Paper. William Michael Driesen, Clifton, N. J., assignor to S. D. Warren Company, Boston, Mass., a corporation of Massachusetts. Application October 5, 1928. Serial No. 310,671. 10 Claims. (Cl. 91—68). Sheet material, comprising a web of paper constructed substantially exclusively of fibers of transparent substance, and a film-matrix of cellulose derivative film-material with anhydrous lanolin dispersed therein, said film-matrix having substantially the same index of refraction as the fiber substance, enclosing the fibers in direct optically uninterrupted contact with their surfaces.

2,018,875—Manufacture of Sized Papers. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H., a corporation of Maine. Application January 12, 1932, Serial No. 586,233. 4 Claims. (Cl. 91—68). A method which comprises treating a fibrous article first with a viscose solution and then with an acidified glue solution, thereby regenerating cellulose from the viscose and producing an exposed glue surface.

2,018,937—Paper Pulp and Method of Making the Same. Sidney D. Wells and Gerald D. Muggleton, Appleton, Wis., assignors to Lewis L. Alsted, Appleton, Wis. Application December 10, 1932, Serial No. 646,588. 5 Claims. (Cl. 92—6). A substantially white bleached fibrous material containing not less than 20% of pentosans and not less than 10% of lignin with the remainder substantially cellulose.

The hereindescribed method of producing paper pulp from fibrous vegetable material which consists in washing the material to free it from non-fibrous foreign matter, crushing the washed material in a rod mill and digesting and disintegrating the material in a cooking liquor obtained in part by forcible removal from the pulp later in the process, blowing steam into the rod mill during the digesting and disintegrating action, thereafter washing the material counter-currently and finally bleaching the material while maintaining the mass alkaline throughout the bleaching operation so as to preclude chlorination of the lignin.

2,018,938—Apparatus For and Method of Treating and Handling Paper Pulp and Similar Fibrous Materials. Sidney D. Wells, Appleton, Wis., assignor to Lewis L. Alsted, Appleton, Wis. Continuation of application Serial No. 619,863, June 29, 1932. This application January 9, 1933, Serial No. 650,935. 19 Claims. (Cl. 92—9). The hereindescribed process of removing printing ink from paper comprising disintegrating the paper and agitating it in a soapy solution until the ink is loosened from the paper and a foamy mass is produced containing substantially no free liquid and having the particles of the ink pigment carried by the films of the bubbles of the foam and separating the bubbles with the ink pigment thereon from the fibers.

An apparatus for removing printing ink from paper comprising means for disintegrating the paper and agitating the same in a soapy solution until a foamy mass is produced consisting of fibers and innumerable soap bubbles on the films of which particles of the ink pigment are carried, means for expressing a portion of said soap bubbles together with the pigment particles thereon from the fibers, means for refoaming the fibers with their remaining soap bubbles, means for separating soap bubbles with pigment particles thereon from the refoamed mass, means for washing the soap bubbles from the fibers following the action of said separating means, and a circulating system for the soapy solution interconnecting said means to cause the soapy solution to travel through the apparatus in a direction counter to that in which the fibers are going whereby to cause the solution to gain and the fibers to lose ink as they pass through the apparatus.

2,019,541—Smoothness Tester. Ralph A. Masten, South Glen Falls, N. Y., assignor to International Paper Company, New York, N. Y., a corporation of New York. Application March 29, 1933, Serial No. 663,329. 9 Claims. (Cl. 73—51). Apparatus for determining the smoothness of paper or like sheet materials which comprises; a smooth surface, means to hold a sample of the material against said smooth surface, means to pass air at substantially constant pressure between the material and said sur-

Competition

is the Life of Trade—an old adage with which you may or may not agree. It is doubtful, however, if you will disagree with the thought that papermaking is a highly competitive business—sometimes too much so.

To reduce some of this competition may be your problem. It may be that to meet it more satisfactorily you have wondered how your production costs could be lowered without sacrificing quality.

If you are still refining your stock in the age-old way, make the New Year Resolve to look into the FRITZ REFINING AND HYDRATING MACHINE and then act upon it. This machine has proved to be a money maker in other mills. It can prove to be one in yours.

Write for complete information.

LOVE BROS., Inc.
AURORA ◆ ILLINOIS

face, and means to indicate the time required for a unit quantity of air to pass.

2,019,598—Production of Cellulosic Materials or Cellulose. Henry Dreyfus, London, England. Application February 11, 1933, Serial No. 656,362. In Great Britain March 4, 1932. 2 Claims. (Cl. 92—11). Process for the manufacture of cellulosic products from lignified cellulosic materials which comprises effecting the separation of the cellulose and the lignin components by impregnating the cellulosic materials under pressure with an aqueous solution comprising metallic bisulphites, Turkey red oil, and free sulphur dioxide, in which solution the proportion of free sulphur dioxide to combined sulphur dioxide is less than 1:2 and then cooking the said impregnated material and the solution at a temperature between 100° and 160° C.

2,019,649—Vertical Drier for Web Material. Earl E. Berry, Beloit, Wis., assignor to Beloit Iron Works, Beloit, Wis., a corporation of Wisconsin. Application June 9, 1933, Serial No. 674,975. 2 Claims. (Cl. 34—48). In a vertical type paper drier, four vertical stacks of drier drums arranged in spaced relation in each stack and in staggered relation in adjoining stacks, an endless felt trained to wrap around part of the peripheries of successive drums in the two inside stacks, and the lowermost drums in the outside stacks, a second endless felt trained to wrap around part of the peripheries of the drums in the outside stacks, said felts cooperating to guide a paper web through the drier in a serpentine path without cutting off vertical air currents through the drier.

2,019,845—Process and Apparatus for Making Branded Paper Board and Product Thereof. Charles C. Colbert, George E. Preston, and Lloyd C. Daly, Elkhart, Ind. Application February 26, 1934, Serial No. 712,946. 18 Claims. (Cl. 92—39). The product comprising paper board having printed identification marks under a surface thereof and a clay coating on said surface, said identification marks adapted to be rendered apparent by wetting the clay coated side of the board.

2,019,903—Manufacture of Crinkled Paper and the Like. Rudolf Heitmann, Mannheim, Germany. Application June 12, 1934, Serial No. 730,224. In Germany June 24, 1933. 6 Claims. (Cl. 154—30). Mechanism for producing crinkled webs and the like material comprising two opposed die plates each of which has a knee bend forming the side walls of the dies and means for moving the plates laterally towards each other.

2,020,056—Automatic Control for Paper Machine Driers. Norman B. Gibbs, Port Angeles, Wash. Application October 11, 1932, Serial No. 637,347. 11 Claims. (Cl. 34—48). In combination with a drying machine having heating rolls and conveying felts for conveying the material to be dried into intimate contact with the rolls, of means for applying moisture to the felts and means controlled by a break in the sheet to be dried passing through the machine for actuating said moisture applying means.

In combination with a drying machine having heating rolls and conveying felts for conveying the material to be dried into intimate contact with the rolls, of means for spraying liquid directly upon the felts, of means for actuating pivoted to the crank lever, the said crank lever being spring set to normally move the piston downward in the cylinder, and a link connecting the other end of the crank lever to the crank on the roller.

2,020,118—Paper Reeling Apparatus. William R. Kellett, Menasha, and Charles M. Pearson, Neenah, Wis., assignors to Paper Patents Company, Neenah, Wis., a corporation of Wisconsin. Application February 23, 1933, Serial No. 657,970. 13 Claims. (Cl. 242—65). In paper reeling apparatus, the combination of a drum, means rotatably supporting the drum, means for delivering a web of paper to the drum, a movable arm for delivering and temporarily supporting a spool in operative position relative to the drum for effecting winding of said web on said spool, a track for receiving said spool from said arm, pneumatic means for actuating said movable arm, and electric means for controlling said pneumatic arm actuating means.

2,020,328—Paper Manufacture. Harold Robert Rafton, Andover, Mass., assignor to Raffold Process Corporation, a corporation of Massachusetts. Application October 8, 1930, Serial No. 487,377. 55 Claims. (Cl. 91—68). That step in a method of manufacturing sized paper filled with alkaline filler comprising applying to a fibrous web containing alkaline filler substantially water insoluble thermoplastic sizing material selected from the group consisting of substantially water insoluble substantially unsaponifiable thermoplastic material, and a solution of substantially water insoluble saponifiable thermoplastic material in a solvent, said sizing material applied to said web being sufficient in amount to impart sizing effect to said paper.

2,020,668—Tissue Handkerchief and Method. Kurt Wandel, New York, N. Y. Application March 22, 1935, Serial No. 12,455. 12 Claims. (Cl. 154—2). The method of making a cellulose tissue handkerchief which consists of individually compressing marginal and transverse portions of each of a plurality of cellulose tissue webs, superposing said webs so that said individually compressed portions coincide, subjecting all of said webs to simultaneous compression inwardly of said individually compressed portions, and then severing along the longitudinal axis of said individually compressed transverse portions.

2,020,928—Laminated Sheet Material. Benjamin Asnes, Framingham, Mass., assignor to Dennison Manufacturing Company, Framingham, Mass., a corporation of Massachusetts. Application October 20, 1934, Serial No. 749,252. 23 Claims. (Cl. 154—33). Laminated material comprising a plurality of sheets adhesively united, one sheet being more wavy than the other so that when the material is stretched crosswise of the waves the other sheet will tear along lines extending transversely of the direction of stretching.

2,021,125—Paper-Making. William P. McCorkindale, South Hadley Falls, Mass., assignor to The McCorkindale Company, Holyoke, Mass., a corporation of Massachusetts. Application November 19, 1934, Serial No. 753,587. 6 Claims. (Cl. 92—40). A paper-making machine comprising in combination, a vat for paper-making material, a movable making member having a foraminous surface adapted to take on paper-making material from the vat to form a sheet, a receiving member adjacent said vat having a perforated surface, a movable carrier having a foraminous member for overlying said perforated surface of the receiving member, suction means associated with the lower side of said receiving member for taking a sheet of paper from said making member and depositing it on said carrier when it overlies said receiving member, and size-applying means associated with said movable making member, all adapted and arranged whereby size may be applied to a sheet of paper on said carrier as the making member moves away from said receiving member.

2,021,172—Paper Impervious to Moisture, Water and Grease. Edmond H. Bucy, Waukegan, Ill., assignor to Atlas Powder Company, North Chicago, Ill., a corporation of Delaware. Application January 21, 1933, Serial No. 652,938. 14 Claims. (Cl. 91—68.) A flexible sheet of paper coated with a composition comprising an oil soluble condensation product of the phenol-formaldehyde type in solution in a drying oil, and casein, said coat being proof to moisture, water and grease.

2,021,310—Continuous Strip Material Process. Edward T. Jaeger, Rockville Centre, N. Y., assignor to Oneida Paper Products Incorporated, Brooklyn, N. Y., a corporation. Application March 24, 1932. Serial No. 600,926. 8 Claims. (Cl. 93—19.) The steps in a continuous strip material process which comprises continuously feeding and forming strip material at a predetermined rate, intermittently producing a slack in said formed material, cutting the material at the slack and thereupon taking up said slack. In combination, means for feeding strip material, slacker rolls in operative relation with said feeding means for receiving said strip material between said rolls, means whereby said slacker rolls control the rate of movement of said strip material, and means for intermittently decreasing and increasing the speed of operation of said slacker rolls below and above the speed of operation of said feeding means for correspondingly increasing and decreasing the rate of movement of said strip material below and above the rate of movement produced by said feeding means for alternately producing and taking up slack in said material.

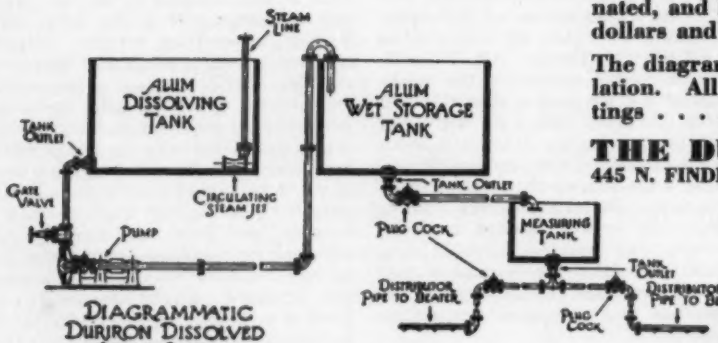
HOW MUCH IS A SHOVELFUL?

When you tell a beaterman to throw in so many shovelsful of alum, are you sure that he never makes a mistake?

If he puts in too much, the paper is brittle, and the excess alum corrodes the wires and deteriorates the felts. Too little alum results in poor sizing and weak paper.

With the Duriron Dissolved Alum System, the superintendent has exact control of the strength and amount of alum used. The gauge glass in the measuring tank tells at a glance how much alum has gone into the beaters. Labor and space are reduced, size precipitation is better, specks and spots are eliminated, and less alum is used . . . sizable savings in dollars and cents.

The diagram shows the features of a Duriron installation. All parts . . . pumps, valves, pipe and fittings . . . are free from any corrosion by the alum.



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DISSOLVED ALUM SYSTEM

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KENWOOD MILLS

ALBANY, N.Y.

KENWOOD WOOL PRODUCTS
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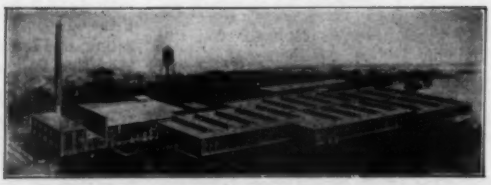
Manufacturers of Kenwood Felts and Jackets for all Pulp and Paper Making Purposes since 1870



KENWOOD MILLS LTD. ARNPRIOR ONTARIO, CAN.

The COMMERCIAL OUTLOOK

New York, January 2, 1936.

THE new year opens with a feeling of confidence almost undivided in the paper industry; as a matter of fact, a large majority within the industry view 1936 with an attitude that is nothing short of bullish. On all sides are heard confident expressions that production and consumption of paper and paper products will continue to show the gains established last year, and rise to new heights since the depression period; that the turnover of business during the current year will far exceed that for some years past, and that probable advancement in market prices will enable paper manufacturers to net better profits than in a long while.

The all-important factor to be considered in the paper industry this year is that of paper prices, manufacturers assert. Stress is put on the fact that production costs have risen steadily during the past couple of years, whereas manufacturers have not altered their sales prices while doing everything possible not to upset the constant improvement in the demand for their product, with the result that many paper mills and converting plants last year ran at a much increased capacity and yet failed to realize proportionate increases in profits. With consuming markets having expanded to where it is felt they can readily withstand at least moderate rises in prices, it is expected prices of most classes of paper will show a more or less steady uptrend during the next few months as mills gradually put their schedules in order for the new year.

That notable gains in manufacturing operations and distribution of product were made during 1935 is beginning to be emphasized by figures now coming out. According to reports to the American Paper and Pulp Association, figures for October showed the paper industry in the United States operating at 75.8 per cent of capacity, as against 64.8 per cent for the similar month of 1934. For the first ten months of 1935, operations approximated 70.7 per cent of capacity. No direct comparison with 1934 is available, but it is indicated that operations during 1935 utilized between 10 per cent and 15 per cent more capacity than in the first ten months of 1934. Since operations at 82 per cent of capacity are generally regarded as representing peak activity, the industry as a whole has materially improved its position and, on the basis of volume, operations are at a very gratifying rate.

The Standard Statistics Company reports that production of all primary grades of paper, including newsprint and paperboards, in the United States for the first eight months of 1935 was approximately 13 per cent larger than for the similar period of 1934. Indications point to further gains during the final months of the year, with the result the total 1935 production probably exceeded that for 1934 by fully 15 per cent.

Exports of paper and paper products from the United States in October last registered a rise of nearly 30 per cent compared with the same 1934 month, according to U. S. Department of Commerce statistics, while exports in the first ten months of 1935 showed a gain of not quite 10 per cent contrasted with the corresponding 1934 period. Aggregate exports were valued at $16,919,902 in the first ten months of last year, against $15,549,545 in the same time of 1934.

Production of newsprint in the United States and Canada during November increased 25,981 tons over the same month of 1934, with United States output showing a moderate rise in contrast with the general downward trend of earlier months last year. Production in Canada, at 262,852 tons, was just slightly under the October figure of 266,515 tons, and was the second best month's output for 1935. It also exceeded the output for any month in 1934 by Canadian mills. United States mills produced 78,929 tons of newsprint in November, compared with 74,933 tons in November, 1934, a gain of 3,996 tons. Mills in both countries produced 341,783 tons in November, against 315,802 tons a year before.

During the first eleven months of 1935 Canadian mills produced 2,508,003 tons of newsprint, contrasted with 2,358,097 tons in the similar period of 1934, an increase of 149,906 tons. On the other hand, U. S. mills lost ground during the period, with total output for the eleven months of 839,938 tons last year, against 885,180 tons in 1934, a decline of 45,242 tons. Mills in both countries manufactured a total of 3,347,941 tons during the first eleven months of 1935, a gain of 104,664 tons over the 3,243,277 tons produced in the corresponding time of 1934. The eleven months' production by Canadian mills established a new high for output of that country. The previous high point was set in 1929 when 2,495,628 tons were produced in eleven months. The United States production for the eleven months compared with the record high for the period of 1,542,415 tons established in 1926.

Shipments of newsprint from mills in both the United States and Canada ran ahead of output during November, U. S. mills shipping 80,875 tons and Canadian mills 285,179 tons, a total of 366,054 tons. As a result, stocks at mills on November 30 last were only 63,387 tons, compared with 87,658 tons a month before and 46,488 tons on November 30, 1934.

Newspaper advertising in November, greater than in October last, reversed a seven-year trend, and although most of the months of 1935 exceeded the corresponding months of 1932, 1933 and 1934, November came the closest to the 1931 line and was less than 4 per cent behind the linage of November, 1931, according to *Editor & Publisher*. The linage barometer rose from 97.7 per cent in October to 105.0 in November, which means, the paper says, "that for the first time in the recovery movement newspaper advertising for a month has exceeded the average for that month in the last five preceding years."

Mills in the United States produced 345,596 tons of paperboard during October last, representing a sharp gain over the 289,596 tons produced in the month preceding, as well as over the 263,679 tons in the same 1934 month, and constituting the largest month's output of board during the past three years, according to Census Bureau figures. Production in October was at 79.5 per cent of mills' rated capacity, against 74.1 per cent in September last year, and 63.9 per cent in October, 1934. Board production during the first ten months of 1934 reached an aggregate of 2,756,171 tons, or at 67.9 per cent of mills' rated capacity, contrasted with 2,345,817 tons and 59.9 per cent of capacity during the similar period of 1934.

Board mills received new orders calling for a total of 351,887 tons of their product in October, against 307,103 tons in the month before, while unfilled orders at the end of October were for 107,074 tons, against 105,088 tons at the end of September last.

◆ ◆

◆ Joseph P. Prescott Retires from Collins

Joseph P. Prescott, retiring vice president and treasurer of the Collins Manufacturing Company, Holyoke, Mass., was tendered a testimonial and farewell banquet at the Hotel Nonotuck in Holyoke, December 19 by the executive and employee personnel of the company.

Wm. C. Bryant, sales manager, acted as toastmaster, and addresses were given by General Manager Herman Grasselt, Superintendent James Fitzgerald, Office Manager H. C. Carruthers, George E. Murphy, Jr., A. L. Foss, Edward Rex and Ralph Tupper.

Mr. Prescott was presented with a scroll and a traveling case, the presentation speeches being made by H. C. Carruthers and A. L. Foss.

Mr. Prescott, who is widely known in the paper industry, has been connected with the Collins Company for many years. He learned the business from the ground up in the local plant and rose to the position he held at the time of his retirement by his ability and executive qualities.

MISCO STAINLESS Centricast HEAT RESISTING PRODUCTS CORROSION RESISTING

Unlike the typical casting made in a stationary mold, MISCO **"Centricastings"** will not distort in cooling, because contraction is uniform and unrestrained due to the absence of sand cores. Cooling strains are virtually eliminated. In consequence MISCO **"Centricast"** products have a degree of soundness, straightness, and concentricity unobtainable by ordinary methods of casting.

MISCO centrifugal castings are recommended for: Tube rolls...Table rolls... Chemical piping... Press rolls... Hollow shafting... Rings of all kinds... Bushings... Valve seats... Cylinder liners.

Your inquiries are invited. Information on MISCO "C" "Centricast" Products will be sent upon request.

10' MISCO "C" "Centricast" pipe.

MISCO
Heat and Corrosion Resistant Alloys

MICHIGAN STEEL CASTING COMPANY
One of the World's Pioneer Producers of Chromium-Nickel Alloys
1992 GUOIN STREET, DETROIT, MICHIGAN

THE DRAPER FELT

Unexcelled for strength, openness, resiliency, and general running qualities. Made to meet the most exacting conditions on all types of machines and all kinds of papers. Only one grade and that the highest.

Made by

DRAPER BROTHERS COMPANY

CANTON, MASS.

Woolen Manufacturers Since 1856

REPRESENTATIVES

L. H. BREYFOGLE, Kalamazoo, Mich. C. K. BEECHER, Delaware, Ohio

PACIFIC SALES COMPANY, Security Bldg., Portland, Ore.

Domestic RAW MATERIALS

◆ Papermaking Rags

While the market for papermaking rags has ruled rather quiet over the holiday and inventory period, it has displayed a very strong undertone and changes registered in quoted prices have been upward practically without exception. A feeling of pronounced confidence concerning the outlook prevails within the trade. Many dealers and importers expect sharp advancement in prices of just about every grade of papermaking rags within the near future, or when mills return to the market in force as buyers to acquire supplies against spring requirements. The supply situation is very bullish as regards most rags, and members of the trade feel this will lead to substantially higher market prices.

One all-important feature in the supply position, according to dealers, is the lack of worthwhile accumulations of almost every kind of rags in any corner of the trade. Demand from mills during 1935—for nearly every class of papermaking rags—was sufficient, it is contended, not alone to readily absorb all the current supply reaching the market, but also to remove any and all the stocks piled up for several years before. Now, it is insisted, mills will not have these accumulations in dealers' and packers' hands to draw on, and it is believed that if consuming demand develops only in the same volume as in 1935, available supplies will fall short of the market's requirements and prices will be forced upward.

Meantime, paper manufacturers are operating in the rag market cautiously, purchasing only needed amounts of rags and striving not to unduly excite the market. Dealers in turn are making sales with care, generally refusing to commit themselves on other than rags actually in hand, and complaining of not being able to get supplies in packing sources or abroad at prices mill customers are willing to meet. The firmest items in the market are several of the highest qualities of new cotton cuttings and roofing rags; in other words, the highest and lowest grades of rags for papermaking are chiefly wanted and show the greatest price strength, as has been the situation for some while.

Dealers are reported ignoring bids of anything under 7.50 cents per pound f.o.b. their shipping points for No. 1 new white shirt cuttings, and it is understood sales have been made at this price or very close to it. Exporters have paid 7.00 cents freely ex dock basis at New York, and have continued to ship considerable quantities of these rags to Europe. Asking prices on new soft unbleached muslins are 7.50 to 7.75 cents a pound at shipping points, while new blue overall cuttings are held at 5.50 cents, light silesias at 5.25 cents, fancy shirt cuttings at 2.75 cents, washables at 2.50 cents, bleached canton flannels at 6.50 cents, and bleached hosiery cuttings at 7.75 to 8 cents.

Roofing rags are moving at maintained prices, and while felt mills show no disposition to pay higher values, they are absorbing the supplies offered without hesitation and meeting steady rates. No. 1 domestic roofing stock is selling at 1.70 cents to perhaps a little higher per pound f.o.b. shipping points, and No. 2 domestic at 1.35 to 1.40 cents. Importers assert that foreign dark cottons of mid-European origin cost them at least 1.60 cents and of Spanish origin 1.40 cents, and that felt mills evince no willingness to meet these cost levels. Foreign linsey garments are quoted to felt mills at up around 1.95 cents a pound ex dock New York. Old white cottons and thirds and blues are in restricted demand and quotably steady though unchanged.

◆ Old Paper

The old paper market is firm of tone and fairly active. In fact, a much better movement of supplies into consuming channels has been noted during the holiday and inventory season than generally is recorded, and the technical position of the market is regarded as favorable. High grades, apparently well sold and in none too plentiful supply, are selling at firm to advancing prices. In the East, No. 1 ordinary hard white shavings have brought 2.25 cents a pound f.o.b. dealers' shipping points, No. 1 soft white shavings 1.90 to 2 cents, and No. 1 hard white envelope cuttings 2.40 cents. Old kraft paper is firm at a cent per pound to perhaps higher for special quality packing, and new kraft grades are selling at premiums in price. Old books and magazines continue on a quotable level of 50 to 55 cents per hundred pounds in the East, while folded newspapers are bringing 30 to 35 cents, No. 1 mixed paper 25 to 27½ cents, and old corrugated boxes 45 cents a hundred pounds.

◆ Rope and Bagging

Distinct strength continues to prevail in old bagging of all kinds, and prices have climbed to new high levels for the present forward movement. It is said consumers in the Middle West have paid up to 2.50 cents a pound for No. 1 scrap bagging, on a delivered mill basis of course, and it is definitely known that 2.35 cents has been freely granted. Old gunny is on about this same price level, if not a shade higher. So short are available supplies of bagging and so active the demand that sellers are quoting both gunny and scrap burlap at virtually the same prices.

Old rope has experienced a spurt of paper mill demand and has improved its quotable position. Foreign No. 1 old manila rope has brought 2.25 cents a pound ex dock at New York in sales to some consuming mills, and yet the principal paper mill buyer is said to be bidding only 2 cents at shipping points for No. 1 domestic rope, though dealers say they question whether any domestic rope is being secured at this price. Old strings of all kinds are in excellent demand, hard to locate in customary quantity and very firmly quoted.

◆ Pulpwood

There isn't much stirring in the pulpwood market at present, but a steady undertone is noted and quoted prices are well maintained. Pulp manufacturers in some cases are reported putting out inquiries concerning supplies but are engaging in very little or no actual buying.

◆ Mechanical Pulp

There is moderate activity in mechanical wood pulp, and producers and importers are looking for a livelier and much more satisfactory market during 1936. Manufacturers in Europe, judging from advices, are putting their houses in order to regulate groundwood output in keeping with the consuming market's requirements and to obtain better prices in sales, and it is felt this situation abroad will spread its helpful influence over the market generally. Demand currently is developing at least consistently and is of fair scope. Prices are steady to slightly firmer; at any rate, the tendency is upward. Canadian groundwood is quoted at about $22 a ton ex dock American Atlantic seaboard, while Scandinavian dry groundwood is $21 to $22, also ex dock at New York or other Atlantic ports. Such domestic manufactured groundwood as is selling in the open market is reported bringing around $22 a ton f.o.b. pulp mills.

◆ Chemical Pulp

It is not by any means an easy matter to locate a domestic pulp manufacturer eager to book orders for bleached sulphite. Most producers of such pulp are sold up to such an extent they are reluctant to accept further commitments even at full market prices. Generally, chemical pulp prices are firm of tone and strongly adhered to by sellers. The quotational range on prime bleached sulphite is 2.50 to 2.65 cents a pound ex dock American Atlantic seaboard, and on prime unbleached sulphite 1.90 to 2.05 cents, according to grade. Bleached soda pulp is 2.50 cents delivered at paper mills, and domestic kraft pulp 2 to 2.25 cents on a delivered basis.

◆ Chemicals

Casein prices are firm and evince a rising trend. Domestic is quoted at 15 to 15.50 cents a pound, according to the grind, and Argentine at 14.75 to 15 cents. Solid caustic soda is firm at 2.55 to 2.60 cents a pound, and soda ash is selling freely on a steady quotable basis of 1.20 cents per pound for the product packed in bags.

"NON-USERS ARE THE LOSERS"

TENAX FELTS

WATER REMOVAL

FINISH—TEXTURE—TRIM

FINISH is the most-often-mentioned quality in all papers and bond. To attain the optimum, use TENAX FELTS in all positions.

TEXTURE is often a very necessary quality, and uniformity is best obtained by using TENAX FELTS in all positions. We specialize in layout for this important quality.

TRIM is a most important feature of TENAX FELTS. Use them in all positions to obtain maximum trim.

"Non-Users Are the Losers"

LOCKPORT FELT COMPANY

NEWFANE, NEW YORK, U. S. A.

WHENEVER YOU ARE READY

TO CONSIDER ways and means of improving the quality of your product through the use of new and improved equipment or perhaps different chemical raw materials, the PAPER and PULP MILL CATALOGUE stands ready to answer many of your questions without hesitation.

Its products' index alone includes the name of practically every item, arranged alphabetically, that might be desired for use in a pulp and paper mill together with a list of representative manufacturers.

Its trade name index answers many "teasers"—gives you the names and addresses of those firms whose products you know by trade name only.

Its advertising pages present an exhibit of many of the products catalogued in the index to permit you to more easily select what you desire.

Its extensive useful information section contains special engineering and other data for specific use in the pulp and paper industry that has been gathered from widely separated sources, so that it might be made available to you as a ready reference.

Refer to this "encyclopedia of information" whenever you desire the facts. It is available to you in your mill.

» » » Address all communications to the « « «

PAPER AND PULP MILL CATALOGUE

333 N. Michigan Avenue, Chicago, Illinois

Import and Export MARKETS

IMPORTS

◆ Wood Pulp

The market for foreign wood pulp seems to be gradually though steadily gathering strength. Not in a lengthy while have producers in practically every pulp manufacturing quarter shown such firmness regarding sales and prices, and although consumers let down in their purchasing during the holiday and inventory period, the temporary quieting of the market failed to have any effect on the strong undertone characterizing pulp quotations. There is a common feeling among a large majority of pulp importers, agents and other sellers, that higher market price levels will be witnessed early in 1936; that while no sharp advancement will be recorded, at least some classes of pulp will move a little upward in price.

Kraft pulp is particularly firm. It is said, and market indications seem to bear out the assertion, that producing mills in Europe are virtually sold out for the first half of 1936, and in some instances have disposed of all their output for the latter six months of the year that they care to sell as yet. It is very apparent that spot supplies of kraft pulp are hard to locate, and also shipments from primary sources over the next several months. Premiums are asked and paid for any near lots of prime kraft, up to 1.95 cents a pound ex dock New York or other American Atlantic ports has been paid, it is reported. Quotations on spot or near supplies are nominally 1.90 to 1.95 cents ex dock Atlantic seaboard, while further off deliveries of kraft range quotably from 1.80 to 1.90 cents. It is stated that no more strictly prime quality kraft pulp is to be had at 1.70 to 1.75 cents, ex dock basis.

Bleached sulphite also displays price strength. Producing mills are reported well sold for sometime ahead, and exercising caution in entering additional sales commitments. Firmness in domestic bleached sulphite is helping foreign pulp of this classification to no small extent. Prime bleached is 2.50 to 2.65 cents a pound for the ordinary grades ex dock American Atlantic seaboard, and higher qualities are quoted well above this range. Strong unbleached sulphite of prime grade is steady at 1.90 to 2.05 cents ex dock. Imported groundwood of Scandinavian origin is steady at $21 to $22 per short ton for dry and $22 to $23 for moist at Atlantic ports. Shippers abroad are exhibiting more firmness regarding groundwood prices, and are offering supplies here with a good deal more reserve. This probably is the result of the agreement of European manufacturers to reduce their output of mechanical pulp 20 per cent commencing in 1936.

Imports of wood pulp into the United States during October last are believed to have set an all-time record for any single month in the trade's history. Official U. S. Department of Commerce figures put the total importations of chemical pulp in that month at 204,154 short tons of 2,000 pounds, air dry weight, valued at $7,733,386, compared with 148,114 short tons of a value of $5,748,988 imported in the preceding month, and 148,157 long tons of a declared value of $6,078,351 in October, 1934. The October imports of chemical pulp brought the total for the first ten months of last year up to approximately 1,350,424 short tons, contrasted with 1,188,773 long tons in the same period of 1934.

Groundwood imports in October last amounted to 27,765 short tons of a value of $479,824, making a total for the first ten months of 1935 of 144,632 short tons, against 136,005 long tons in the corresponding ten months of 1934.

Pulp importers and agents are of the opinion that a good many paper and board mills have the major portion of their 1936 requirements yet to cover and are anticipating another buying spurt shortly. Meanwhile the market is almost entirely bare of selling pressure, with buyers on the defensive, especially as concerns prompt or near supplies of most classes of wood pulp.

◆ Paper

Imports of newsprint into the United States in October last continued to show a slight rise over the same month in the preceding year. Imports for the first ten months of 1935 reached a total of 1,899,136 tons, valued at $65,691,577, according to U. S. Department of Commerce statistics, an increase of 6 per cent over the same 1934 period. Prices continued to hold steady at an average of around $34 per short ton, according to the declared value of imports.

The value of other classes of paper and paper products imported into this country rose 50 per cent in October compared with the corresponding 1934 month. While most classes contributed to this increase, particularly heavy gains were noted in receipts of kraft wrapping, paperboards and leatherboards.

◆ Paper Stock

The United States imported 27,068,347 pounds of rags for papermaking, valued at $317,829, in October last, making a total for the first ten months of 1935 of 159,382,506 pounds of a declared value of $1,909,115, and showing a large gain over the 89,656,857 pounds of a value of $1,133,039 imported in the corresponding ten months of 1934. Imports of miscellaneous paper stock, comprising old rope, bagging, waste paper, etc., in October last amounted to 7,143,098 pounds of a value of $104,003, bringing the total for ten months last year up to 62,264,108 pounds of a declared value of $891,188, against 44,444,289 pounds of a value of $622,215 in the same time of 1934.

Imports of all kinds of raw material for papermaking, including pulpwood, woodpulp, rags and waste, reached a total value of $65,022,223 during the first ten months of 1935, registering an appreciable increase over the $58,970,099 worth of similar importations in the same period of 1934, according to government figures.

EXPORTS

After a slight recession during the months of August and September, exports of paper and paper products again took an upward turn in October and shipments in that month exceeded those of the corresponding month in 1934 by nearly 30 per cent. For the ten-month period of 1935, the total shows a gain of almost 10 per cent compared with 1934. If this trend was maintained during the final two months of 1935, the United States export trade in paper and paper products for last year passed the $20,000,000 mark. An encouraging feature is that nearly all items on the schedule showed a rise in quantity as well as value. The only notable exceptions are wrapping papers and overissue news, shipments of which dropped 15 per cent last year compared with 1934. Exports of boxboards and other paperboards were up about 20 per cent in 1935, and a somewhat larger increase took place in shipments of wall and insulating boards. Exports of fine papers were well ahead of 1934, writing papers showing a rise of 40 per cent. The least advance appears to have been made in shipments of newsprint and a number of converted items, such as towels and napkins, filing folders and office forms, boxes and cartons, paper bags and envelopes.

Total exports of paper and paper products in October last amounted in value to $1,912,715, making a total for the first ten months of 1935 of $16,919,902, contrasted with $15,549,545 in the corresponding ten months of 1934.

Exports of paper base stocks declined slightly during October, but the ten months' total last year, valued at $7,764,594, showed a rise of nearly 20 per cent compared with $6,593,837 for the similar ten months of 1934.

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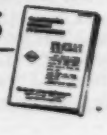

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